Green Infrastructure in the Nansemond River Watershed

This report was produced by the City of Suffolk in cooperation with Isle of Wight County and our community partners. Assistance was provided by the Green Infrastructure Center.

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ACKNOWLEDGEMENTS

The Nansemond River Watershed Green Infrastructure Study was made possible by the hard work and generosity of many individuals and organizations. The City of Suffolk and the Green Infrastructure Center would like to thank our partners and participants, as well as the sponsors who made the project possible. We wish to extend our thanks to the state agencies, scientists, and organizations that have shared their time, data, models, technical support, and expertise. Without these dedicated organizations, our work would not be possible.

PROJECT SPONSORS

PROJECT PARTNERS

PROJECT TEAM

Karen Firehock, Executive Director, Green Infrastructure Center, Inc.
Andrew Walker, GIS Analyst and Land Planner, Green Infrastructure Center, Inc.
Lara Johnson, Urban Forester, Green Infrastructure Center, Inc.
Chris McCormick, Community Landscape Associate, Green Infrastructure Center, Inc.

Robert Goumas, AICP, Assistant Director of Planning, City of Suffolk
Claire Jones, AICP, Comprehensive Planning Manager, City of Suffolk
Amy Thurston, Planner I, City of Suffolk

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INTRODUCTION

In August 2015, the City of Suffolk applied for a Green Infrastructure Community Planning Grant through the Green Infrastructure Center, Inc. (GIC) and the Virginia Department of Forestry. This grant program provides technical assistance to help communities map, evaluate, and plan for conserving their best natural resources: their green infrastructure. As one of the fastest growing localities in the Commonwealth of Virginia and one with an involved and active citizenry, the City recognized the need to identify and protect vital resources as well as the natural and manmade environment that make this place unique. Together with its community partners, the City of Suffolk sought assistance in support of a green infrastructure initiative within the Nansemond River Watershed. This watershed, which encompasses a large portion of the City and extends into neighboring Isle of Wight County, is an area where development is and will continue to be concentrated.

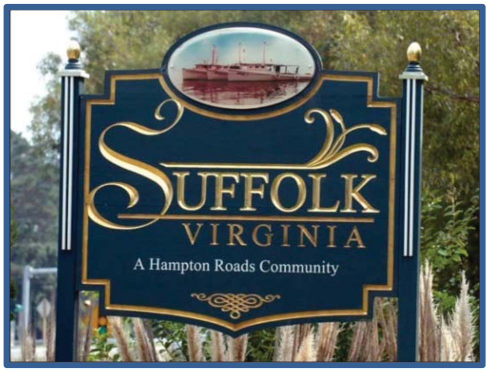
In order to aid in the conservation and enhancement of vital environmental, agricultural, and historical features, the Green Infrastructure Study for the Nansemond River Watershed provides data that identifies natural and cultural assets, developed and vacant land, and opportunities to enhance resource protection, connectivity, and recreational amenities for the larger community. The key to making good decisions is information. A green infrastructure approach allows communities to first protect as much of the natural landscape as possible and to recognize opportunities to restore it where it has been lost. ***In short, focus first on conservation, then restoration and lastly, mitigation to offset unavoidable impacts.***

A successful green infrastructure study includes four main parts: 1) Background information including the context, process, and participants, 2) An inventory of natural assets which are displayed in the form of maps, 3) A series of public forums and committee meetings to collect public input, and 4) A list of goals, objectives, and tasks that are realized from the study process.

BACKGROUND

The City of Suffolk, home to approximately 91,700 people and encompassing roughly 430 square miles, is located in the Hampton Roads region of southeastern Virginia. It is a diverse community with a historic downtown core, large tracts of industrial land, forested lands, farms, many and varied subdivisions, and several rural villages. Many of the rural development patterns of the City of Suffolk extend westward into Isle of Wight County. Suffolk also contains many environmentally sensitive features, including forests, lakes, rivers, streams, and pastures, that are shared with Isle of Wight County. The most predominant environmentally sensitive feature is the Nansemond River and its tributaries, which provide most of the drinking water to the Greater Hampton Roads region and support a large portion of the region's wildlife.

The principles and values statements included the City of Suffolk's 2035 Comprehensive Plan represent the shared vision of the community and a starting point for this study. They include protecting the natural, cultural, and historical assets of the City. During public meetings, residents emphasized the value of Suffolk's natural assets. The rural open spaces, an undisturbed rural night sky, the character-defining waterways, and the Great Dismal Swamp are treasured in the community and contribute to the quality-of-life. These natural assets, as well as the cultural and historic ties to the Nansemond, the defining early years of America, and agricultural production, are a part of what Suffolk is today, and should be preserved for the enjoyment and enrichment of future residents. Preservation of the agricultural heritage and character of the City is also strongly supported by the public and is guiding a principle of the focused growth approach.



2035 Comprehensive Plan policy and action statements that support this study:

- Policy 2-2: Assure that development occurs in a predictable and orderly manner.
- Action 2-2C: Continue the use of cluster developments to preserve and protect the natural environment.
- Action 4-5F: Create, designate and implement a bikeway and trail system serving both recreational and functional purposes.
- Action 4-5I: Develop a “Complete Streets” policy for roadways in growth areas and/or neighborhood communities that are intended to be more pedestrian and bicyclist friendly.
- Action 5-3B: Develop and adopt post-disaster procedures to guide decision-makers in areas such as emergency permitting, rebuilding, citizen outreach, and mitigation opportunities.
- Action 5-3D: Develop strategies which decrease the conflict of increased residential development adjacent to the wildland/urban interface.
- Policy 5-4: Develop strategies to ensure that low-lying areas of the City located along the James and Nansemond Rivers and their associated tributaries are not adversely impacted by sea level rise.
- Policy 5-19: Develop strategies and programs which protect drinking water quality.
- Policy 7-1: Preserve and protect Suffolk’s agricultural heritage.
- Policy 7-2: Protect the City’s natural resources from the negative impacts of development.
- Policy 7-3: Promote Suffolk as a destination for eco-tourism.
- Policy 7-4: Preserve the City’s Historic Resources.
- Action 7-4D: Consider establishing development encroachment protection zones around the City’s historical villages and individual properties to better protect and buffer these cultural resources from encroaching non-compatible development.

Study Area

As previously noted, the Nansemond River watershed includes much of the City of Suffolk and extends into neighboring Isle of Wight County. Within the City, the watershed is an area where development is already concentrated and where additional development is expected to continue. It is also home to most of the reservoirs supplying drinking water to the Greater Hampton Roads region. Marsh systems along the Chesapeake Bay watershed shoreline in Suffolk, particularly the Nansemond River and associated creeks are noted for being a highly valuable resource for marine life. As such, they provide nursery areas for many of the species of finfish and shellfish in the Hampton Roads Region. For all of these reasons, the Nansemond River watershed was chosen as the focus area for this study.

Objectives

This green infrastructure study supports the growth management strategies already in place in the Nansemond River watershed. The ultimate goals for conducting this study are to use this data and public input to help inform future planning initiatives, guide responsible resource management within the watershed, and guide smart integration of green infrastructure considerations into a variety of other plans (such as stormwater, parks and recreation, among others). Specifically, this study aims to capture data to support the following objectives:

- Protect drinking water reservoirs and other water resources
- Reduce flood risk and improve floodplain management
- Meet water quality standards in impaired areas
- Reduce stormwater runoff
- Re-green impervious areas
- Promote sound development practices
- Promote tourism
- Protect and enhance viewsheds
- Promote healthy lifestyles and nature-based recreation
- Restore and protect cultural resource settings
- Improve connectivity and walkability
- Protect prime farmlands
- Increase river access

Process

This study was strategically developed using the following steps:

1. *Set goals*- What does our community value?
2. *Data review*- What do we know and what do we need to know?
3. *Asset mapping*- Map the community's ecological, cultural, economic and historic assets.
4. *Risk assessment*- Find out what is at risk and discuss potential preservation strategies.
5. *Refine goals, create objectives and example tasks*- Use input from advisory committee meetings and public forms to formulate objectives and example tasks.
6. *Create report*- Create report based on public input and assistance from GIC

Cooperation and Partnerships

This study was a community-initiated effort; it involved collaboration among various community organizations, including Citizens for Green Space and Nansemond River Access, the Suffolk Partnership for a Healthy Community (Healthy Suffolk), and the Nansemond River Preservation Alliance, in conjunction with the Green Infrastructure Center, the City of Suffolk Departments of Planning and Community Development, Parks and Recreation, and Public Works, and Isle of Wight County's Planning Department.

It was important for this study to include a wide range of ideas and perspectives in order to develop goals that best reflect the needs and desires of Suffolk and Isle of Wight residents. Local non-profit organizations, business owners, and citizens were asked to participate as advisory committee members and forum participants.

Green Infrastructure Advisory Committee members:

Elizabeth Taraski	Nansemond River Preservation Alliance
James Winters	Nansemond River Preservation Alliance
Jean Carmean	Healthy Suffolk (Suffolk Partnership)
Caroline Martin	Healthy Suffolk (Suffolk Partnership)
Cindy Ferguson	Citizens for Green Space and Nansemond River Access
Monette Harrell	Citizens for Green Space and Nansemond River Access
Joyce Trump	Citizens for Green Space and Nansemond River Access
Claire Jones	City of Suffolk Planning
Amy Thurston	City of Suffolk Planning
Mike Kelly	City of Suffolk Parks and Recreation
Erin Rountree	City of Suffolk Public Works
Kim Hummel	Isle of Wight County Planning

Throughout the study process, the advisory committee met regularly to review data and to develop a vision and goals for the use of this data. For the watershed within the City of Suffolk, where development pressure is higher, consideration of the needs of both the natural and built environment were of particular interest to committee members and were the focus of the vision statement developed by the group.

Vision Statement

Suffolk will support a culture that is equally concerned with the natural and the built environment. Suffolk will become a destination for outdoor recreation, with access to the Nansemond River and support and protection for its diverse culture.

The following goals were also developed by the committee as a result of conducting this study:

1. Protect and connect habitats to support biodiversity and healthy landscapes.
2. Improve and protect water quality for wildlife, fish, and people.
3. Provide and expand trails throughout the watershed to improve community health and access to nature.
4. Promote and protect the City's rich heritage and culture.

WHAT IS GREEN INFRASTRUCTURE & WHY DO WE NEED IT?

Just as cities plan for sidewalks and roads, which can be referred to as "gray infrastructure," cities also need to plan for "green infrastructure." Green infrastructure consists of natural resources, working landscapes, and stormwater management systems; examples include: soils, trees, farms, forests, lakes, rivers, wetlands, open space, and parks and trails, among many others. These features are referred to as a type of infrastructure because they are equally as important as gray infrastructure in providing daily benefits to human health, wildlife, the economy, and overall prosperity. Furthermore, they are considered 'assets' for a community because they help to keep cities cleaner, cooler, and more attractive. They also provide recreation, absorb and filter stormwater, and support native species and tourism.

Green Infrastructure is a term that was first coined in 1994 by agency staff in Florida to explain to the governor that nature is part of our ‘infrastructure’ because it also supports our existence. They developed a model to locate and depict the state’s best habitats for wildlife, water recharge, recreation uses, scenic views, and other benefits. Other states such as Maryland, Montana and California also created state models of green infrastructure.

In 2006, the U.S. Environmental Protection Agency expanded the definition of green infrastructure to also include constructed stormwater best management practices using green features like green rooftops, rain gardens, or cisterns. Today, the Virginia model of habitat cores and corridors considers many factors to show the best habitats statewide as well as how they may connect to the Nansemond River watershed.

While the types and forms of green infrastructure continue to expand as new innovations are made, the overarching goal remains the same: to protect and improve the quality of the environment for wildlife and people.

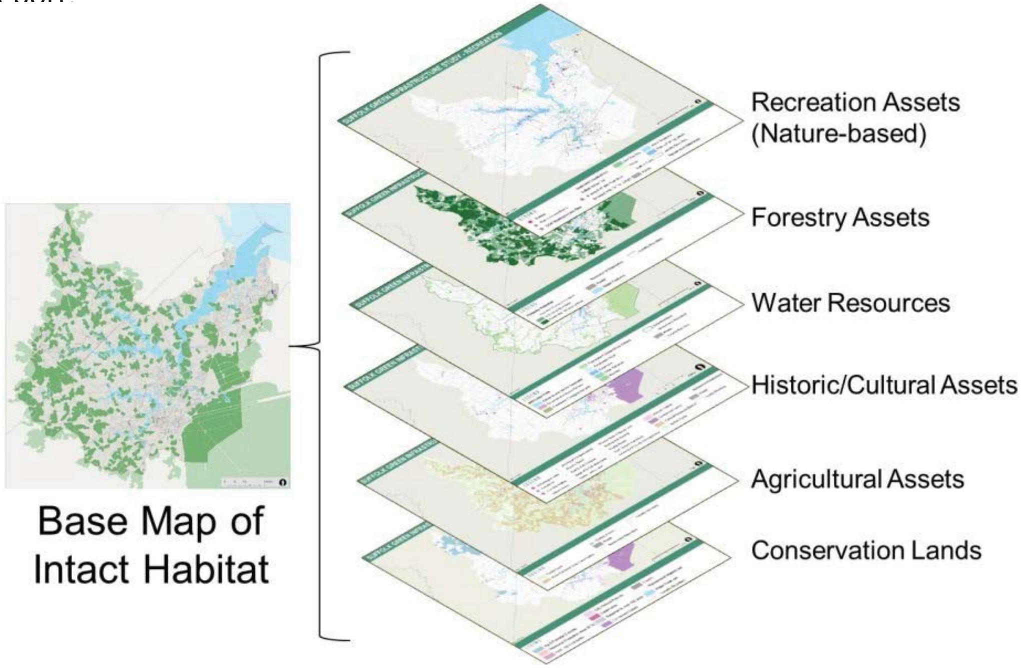
Global climate change, sea level rise, extreme weather events, population growth, depletion of natural resources, and increased development pressure have led many local governments to

research the current state of their natural resources and strategize potential methods to preserve them before they are lost. The City of Suffolk is not alone in facing these challenges. In the past two decades, Suffolk has experienced a substantial amount of growth as employment opportunities, retail centers, and new residential subdivisions have extended westward. These highly desirable areas are located within close proximity to the Nansemond River, which is one of the City’s most significant natural resources. The watershed is also a major supply of drinking water in the region. It is critical that the City take steps to preserve its valuable resources and promote the future resiliency of the communities that depend on it. This watershed still has an abundance of land that may be developed, which if not responsibly developed, may result in a loss of thousands of acres of natural resources and wildlife.

Citizens in the watershed already recognize the value of the Nansemond River as a resource to the community and have pointed to opportunities lost and opportunities still to be gained in protecting and enhancing the watershed and the lifestyles of those who live within it. As a result, the City of Suffolk has initiated this green infrastructure study in order to procure the data necessary to improving the protection and enhancement of our natural, cultural, and historic resources within the Nansemond River watershed. This data will support more thoughtful and informed decisions to protect this resource for current and future generations.

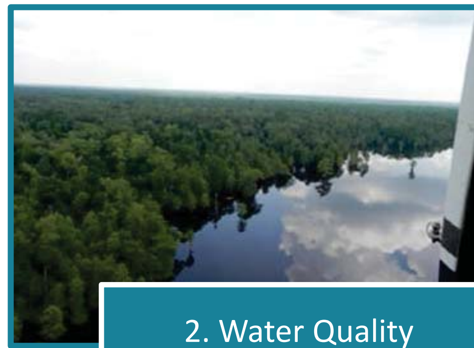
INVENTORY OF NATURAL ASSETS

In order to plan for the future of green infrastructure in the Nansemond River watershed, first the community must develop a thorough understanding of what resources exist currently, including the location, extent, and condition of each resource. The Green Infrastructure Center created a series of inventory maps using spatial data in geographic information systems (GIS) in order to catalogue the City's highest value assets. These maps enabled the project team and public participants to visually analyze significant natural, cultural, and historic assets within the Nansemond River watershed. All public comments were recorded and are included in Appendix A of this report.



The inventory maps developed by the Green Infrastructure Center were sorted into four categories or themes in order to guide the project team in creating long-term goals. The categories are as follows:


1. Habitats


2. Water Quality


3. Parks, Trails, and Access to Nature


4. Culture and Heritage

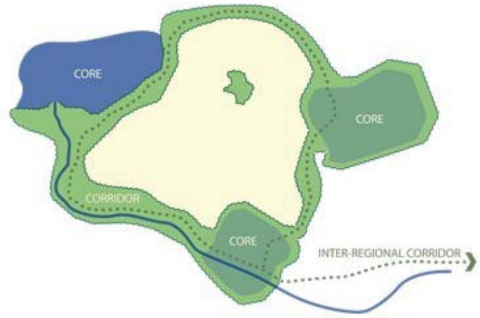
Category 1: Habitats

Habitats of all shapes and sizes are important to consider because together they make a large cumulative difference on the quality of a community's air, water, and biodiversity. From small neighborhood level habitats to regional scale habitats, such as the great dismal swamp, all of these features matter and should be studied as part of a network of habitats.

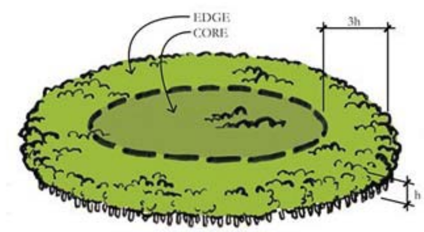
The most significant habitats are known as habitat cores (or ecological cores); these are the most central and intact sections of habitat that are sufficiently large, at 100 acres of more, in order to support a variety of species. Habitat cores should not be fragmented by roads or power lines; they should only consist of undisturbed wildlife and native plants that are protected from encroachment. The edge, which surrounds the habitat core on all sides, provides a protection buffer for the core while still providing habitat for small animals such as rabbits. Edges absorb outside impacts associated with human intrusion, such as noise and pollution. They also protect from erosion, wind, and invasive plant species that should not exist in the core. The last type of habitat is a corridor, which is a linear form of habitat that provides a connection between various habitat cores. Habitat corridors should be at least 300 meters or 985 feet wide in order to provide safe passage for wildlife and buffer against human intrusion and invasive species. These concepts are further explained in the following graphic.

Key Definitions:

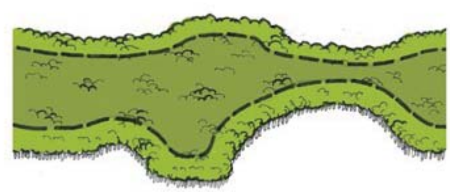
Core: *A core is an area or patch of relatively intact habitat that is sufficiently large to support more than one individual of a species. Consider that the greater the number of interior species present and the greater the diversity of habitats, the more important it is to conserve the core intact.*



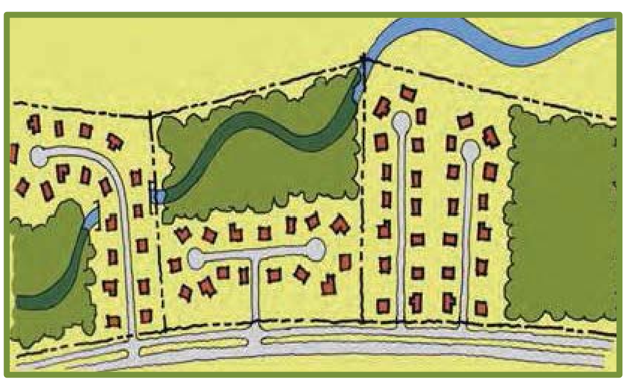
Edge: *The transitional boundary of a core, where the vegetation assemblage and structure differs markedly from the interior, such as forest edges. The structural diversity of the edge (with different heights and types of vegetation) affects its species diversity, as well as the prevalence or abundance of native or invasive species.*



Corridor: *A more or less linear arrangement of a habitat type or natural cover that provides a connection between cores and differs from adjacent land. Corridors are used by species to move between cores, need to be wide enough to allow wildlife to progress across the landscape within conditions similar to their interior habitat. For this reason, it is recommended that these connections be at least 300 meters wide: a central 100-meter width of interior habitat, with a 100-meter edge on either side to protect safe passage and buffer against human intrusion and invasive species. Streams are natural corridors and the width of the vegetative corridor on either side should reflect the stream order (i.e. larger streams need wider forested buffers).*



The key to maximizing the benefits of each individual habitat, no matter the size, is to provide sufficient connections between them by creating multiple habitat corridors. This way, if one pathway is lost or destroyed, there will be other ways for species to cross the landscape. Connected habitats, as shown by the image below on the right, allow for the migration of plant and animal species. Without migration these species may not survive due to a lack of food or water. One of the dangers of isolated habitats is that, over time, genetic diversity will be reduced and inbreeding will lead to vulnerability to various diseases and genetic defects. Just allowing some migration and exchange of genetic materials with other populations can reduce genetic risks and make species more robust in the face of all kinds of threats (Richard, 2011).

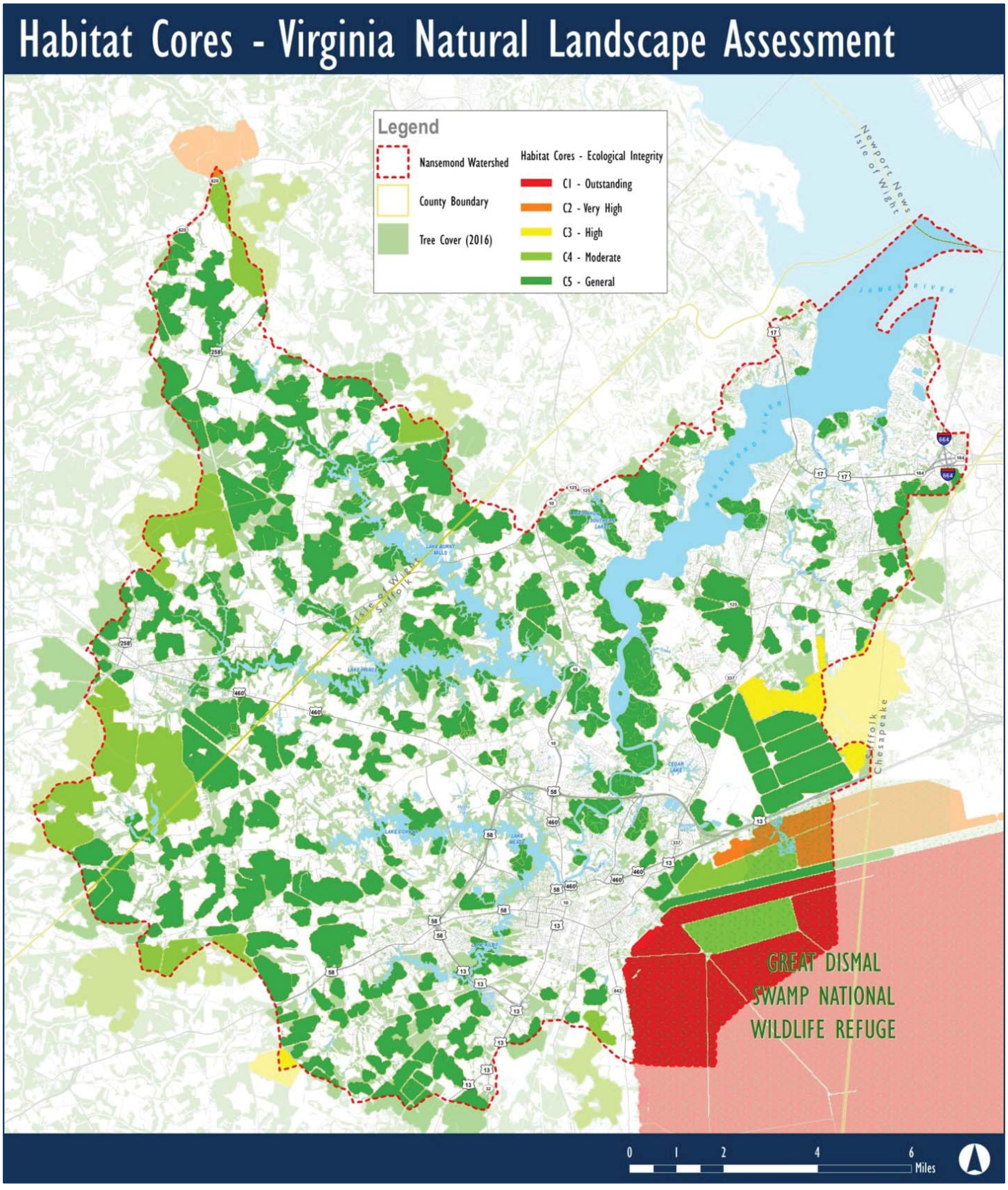


Small habitat patches are also very important because they support pollinators which are essential to plant reproduction and the production of most fruits and vegetables. Shrubs, native grasses, and flowers within small habitat patches provide homes for birds, salamanders, rabbits, other small animals and insects. Since it may not be feasible for a city to create one new large habitat core or corridor, as an alternative they should consider planting several small habitat patches intermixed throughout the landscape.

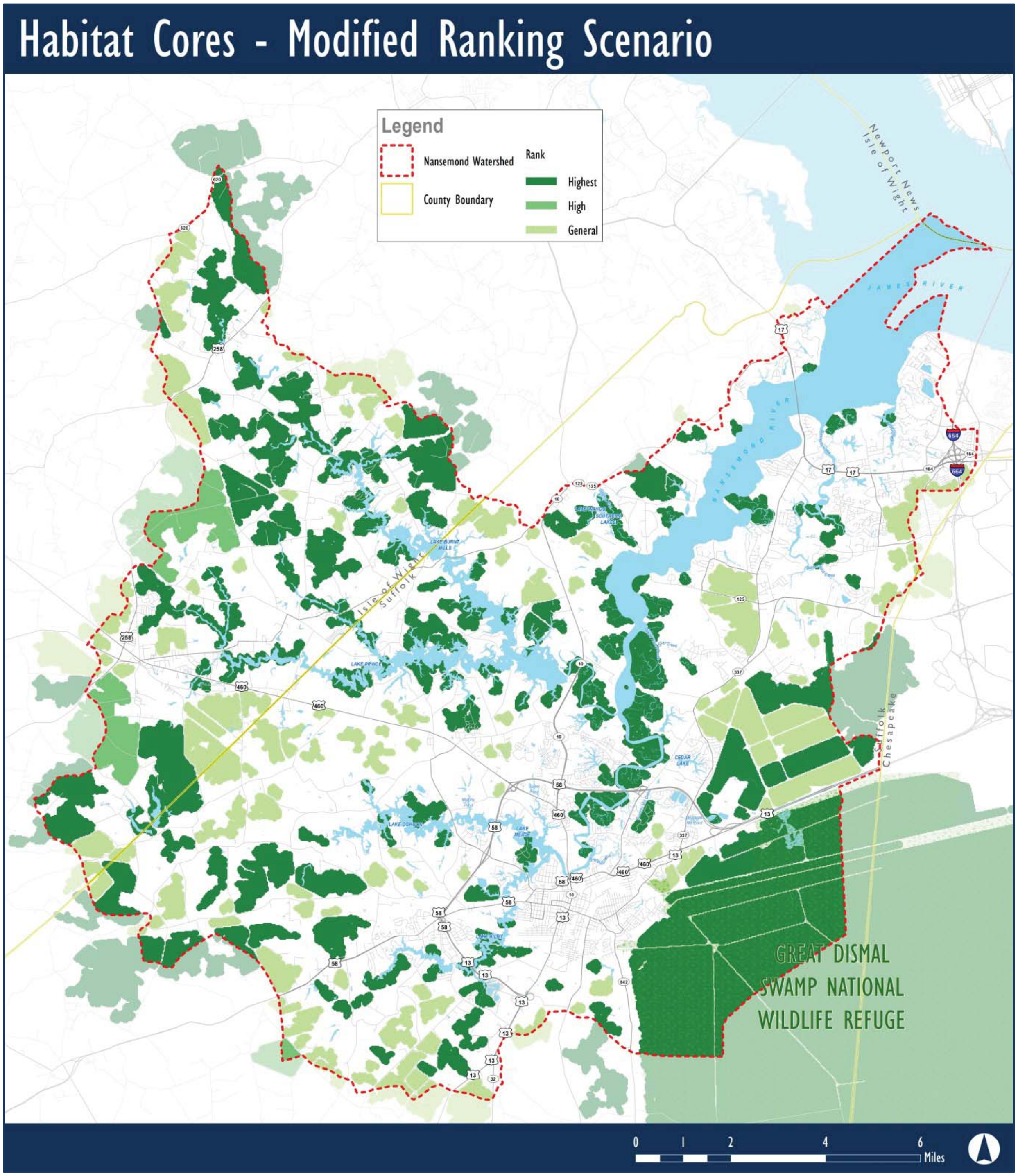
Highways are the biggest threat to habitat fragmentation as they create impassable zones for long distances. This man-made overpass on the TransCanada Highway is an example of a wildlife bridge that allows for the movement of animals from one habitat core to another. ("Man-made Corridors") Wildlife underpasses and tunnels are other techniques used to connect habitats across roadways.

The map on the following page shows habitat cores (or ecological cores) that are 100 acres or more and were found to be either wholly or partially located within the Nansemond River watershed, totaling about 52,000 acres. These cores were identified by the Virginia Natural Landscape Assessment (VaNLA), a mapping effort performed by the Virginia Department of Conservation and Recreation (DCR) in 2007. The Virginia DCR also calculated a number of metrics for each habitat core; their process is summarized below:

> "Over fifty attributes were assigned to the ecological cores providing information about rare species and habitats, environmental diversity, species diversity, patch characteristics, patch context, and water quality benefits. These attributes can be used by planners to select ecological cores that have the characteristics and provide the benefits of greatest interest to them. To assist in identifying highly significant ecological cores, VNHP selected nine ecological attributes and used them in a principal components analysis to develop a prioritization by ecological integrity… The resulting scores were classified into five categories of ecological integrity: C1 - Outstanding; C2 - Very High; C3 - High; C4 - Moderate; and C5 - General."

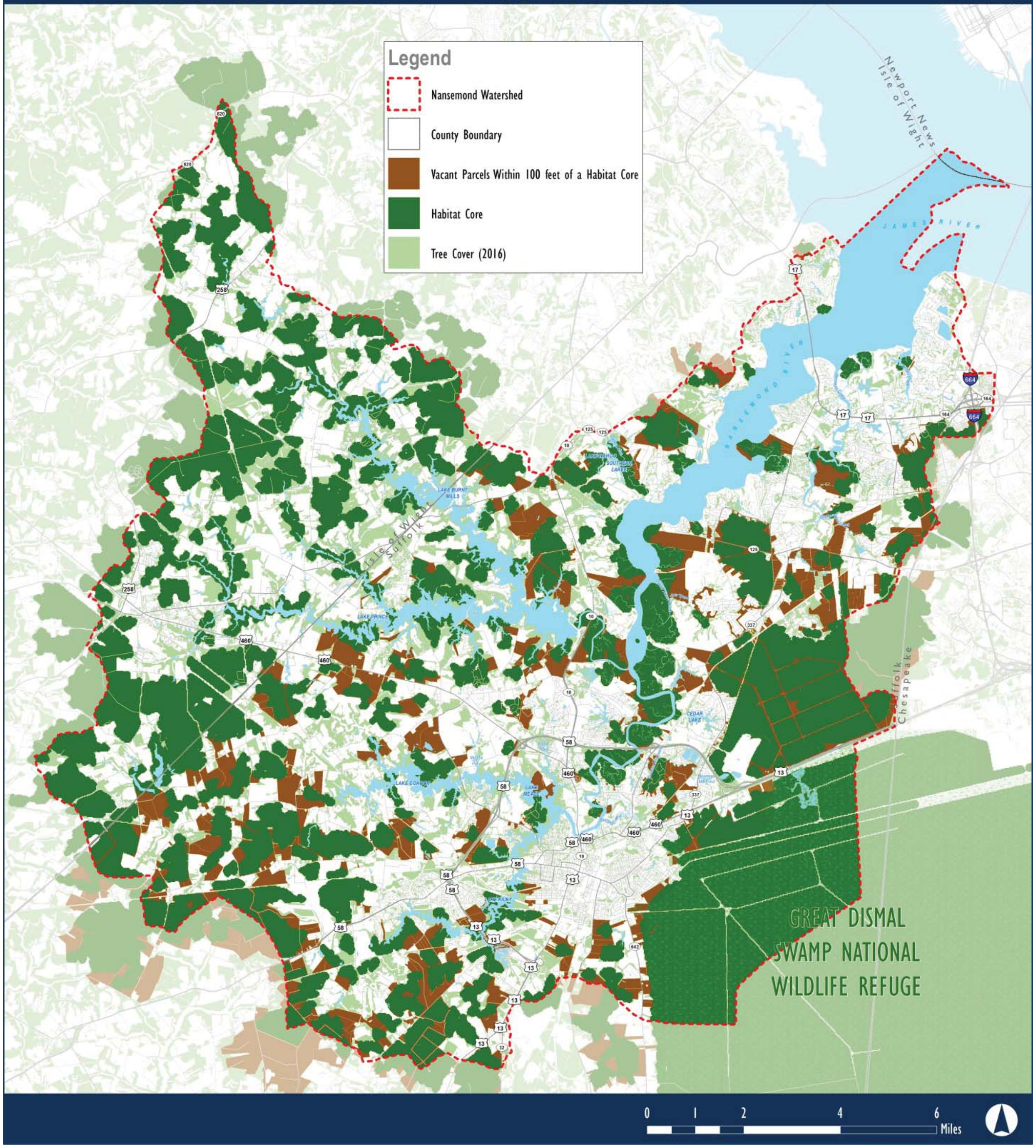


The VaNLA model provides an overview of where large areas of habitat remain relatively undisturbed (not fragmented by roads, buildings, etc.). The model also provides a ranking of estimated ecological integrity, which can guide communities in prioritizing their conservation efforts. Many of the cores in the Nansemond River watershed are either classified as "General" or "Moderate," mostly due to their small size or highly fragmented landscape. Under this model, the Great Dismal Swamp is the only "Outstanding" habitat.

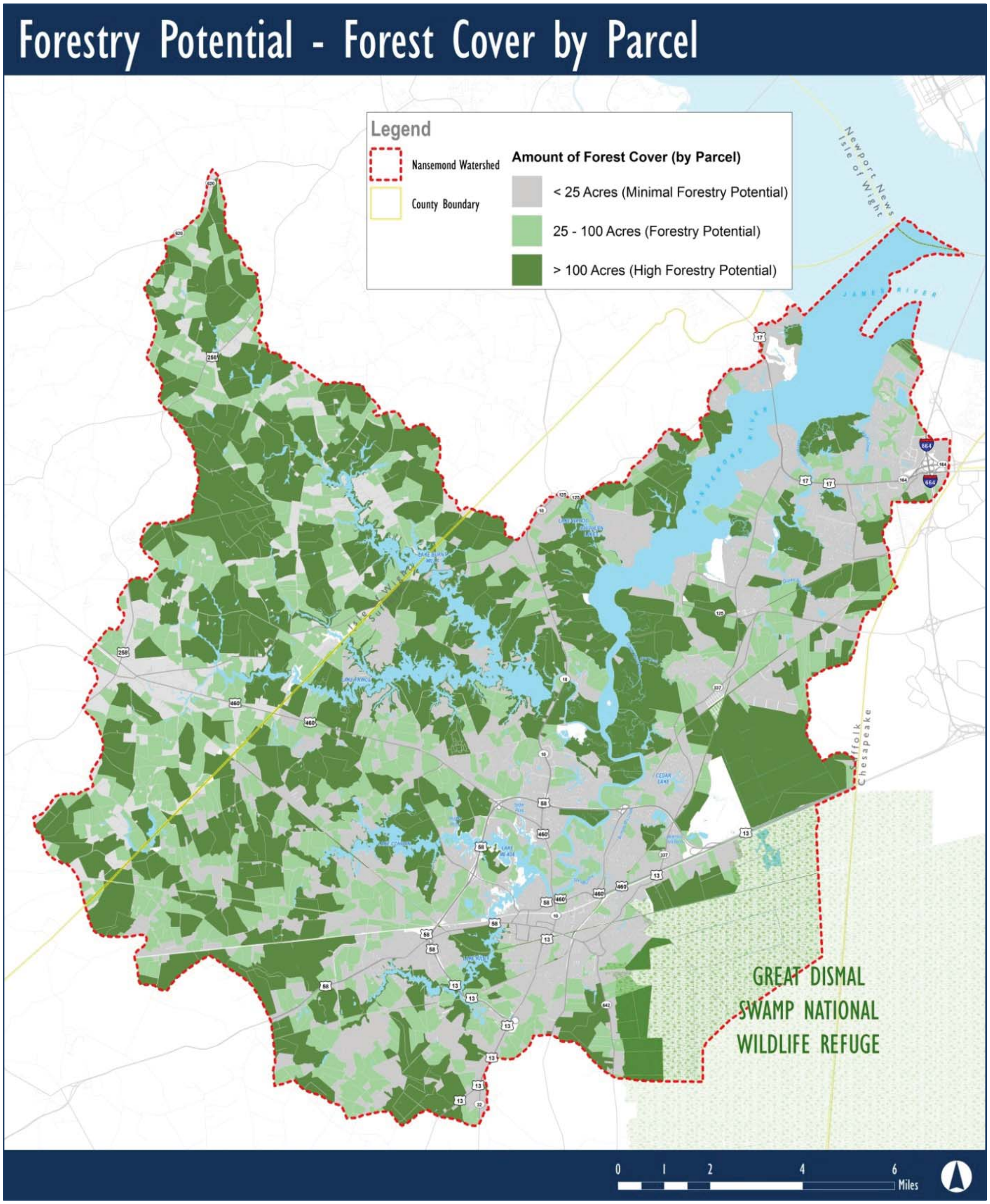


Unlike the VaNLA model which ranked habitats based on nine attributes, the Modified Ranking Scenario ranks habitat cores based on their proximity to surface water, a characteristic the advisory committee identified as imparting higher value to the community. Some of the cores that were ranked lower by the VaNLA model are ranked higher when categorized using this method. This data could be used to prioritize conservation efforts on properties that have the most direct impacts on the Nansemond River watershed; however, relying solely on this method for conservation or green infrastructure planning does not consider the unique characteristics associated with each individual habitat. For this reason, it is important to analyze data using multiple ranking models in order to make well-informed decisions.

Habitat Cores + Potential Opportunities for Connections

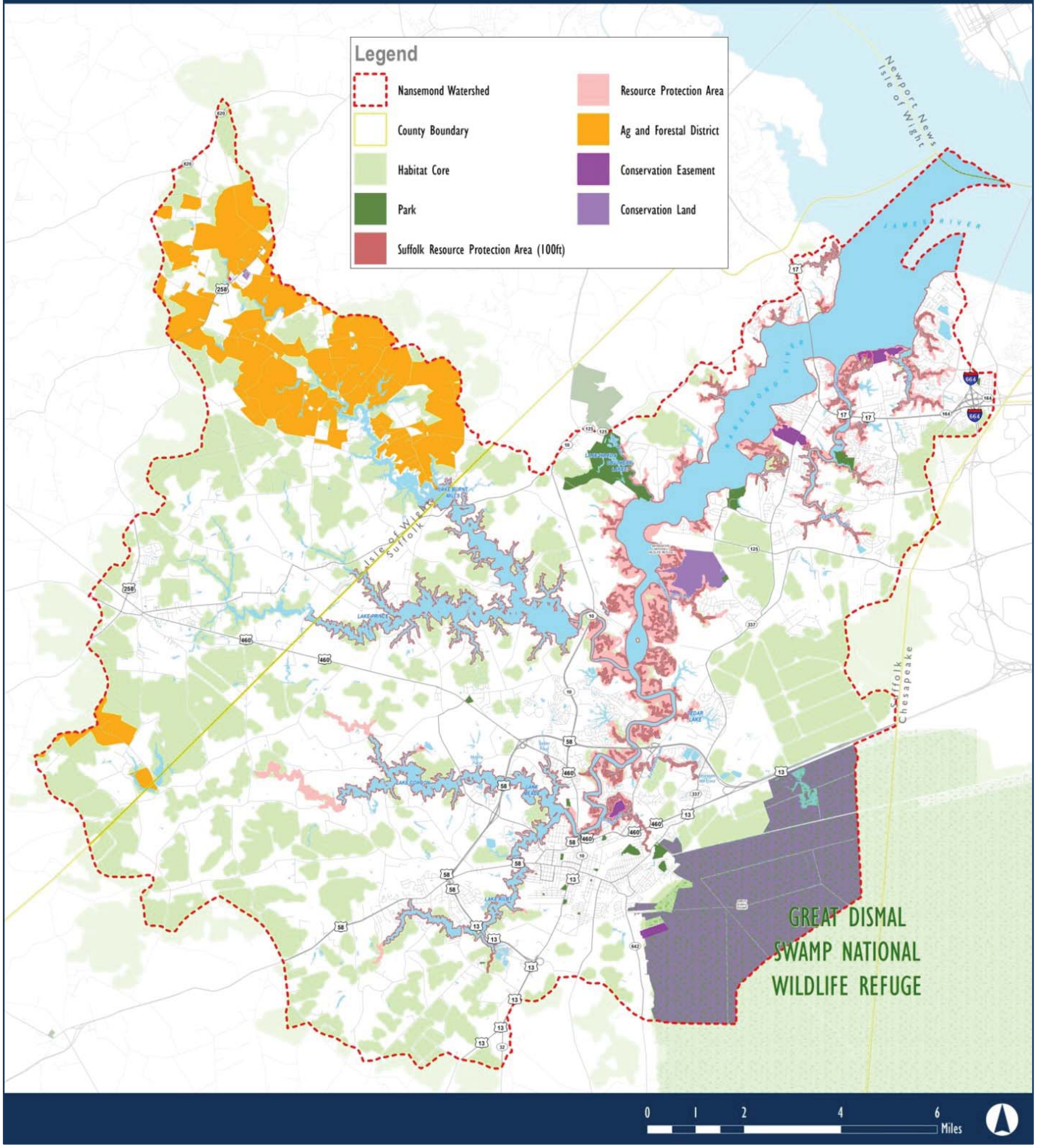


Combining vacant parcel data (which are defined as parcels with no impervious surfaces) with habitat core data will assist the City of Suffolk and Isle of Wight County in identifying potential opportunities for habitat expansion and connections. Parcels with existing tree cover that are located adjacent to habitat cores are good candidates for habitat preservation or creation. Similarly, deteriorated habitats located near habitat cores should be prioritized for restoration or replanting because these areas can form habitat edges that protect the cores from encroachment.



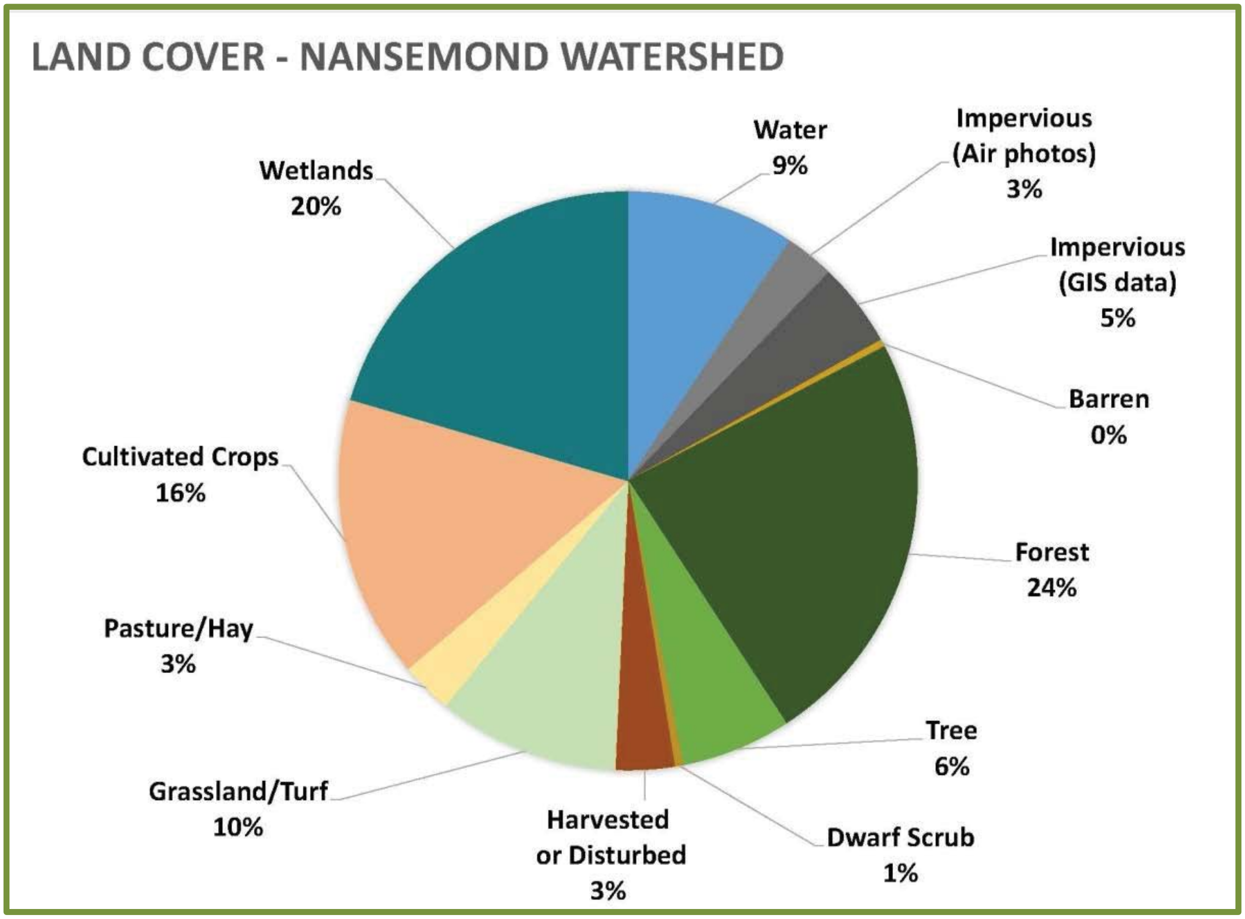
Forest cover data by parcel can be used to show a high-level estimate of the overall forestry potential within the watershed. Like the previous map, this information can help determine ideal parcels for habitat corridors and edges. Parcels that are 100 acres or more have the most potential for sustained forestry activities. Small parcels that are less than 25 acres are often less economically viable for forestry operations. Aside from a few exceptions, the parcels with high forestry potential are located outside of the Northern and Central Growth Areas.

Land Protection Status



A number of data layers were incorporated to show which land areas are protected within the watershed. This data can be used to identify sites that would be good candidates for conservation easements or other conservation methods such as a Transfer of Development Rights (TODs). Land located adjacent to the Nansemond River and its tributaries, or located next to significant habitat cores, such as the Great Dismal swamp, should be prioritized for conservation or protection if possible.

Data from the statewide Land Cover Dataset, part of the Virginia Base Mapping Program, provides a breakdown of the types of land cover present within the Nansemond River watershed. This data will assist the City of Suffolk and Isle of Wight County in establishing long-term goals for land cover conversion and preservation. Likewise, this data can be used to monitor and track changes in land cover over time.

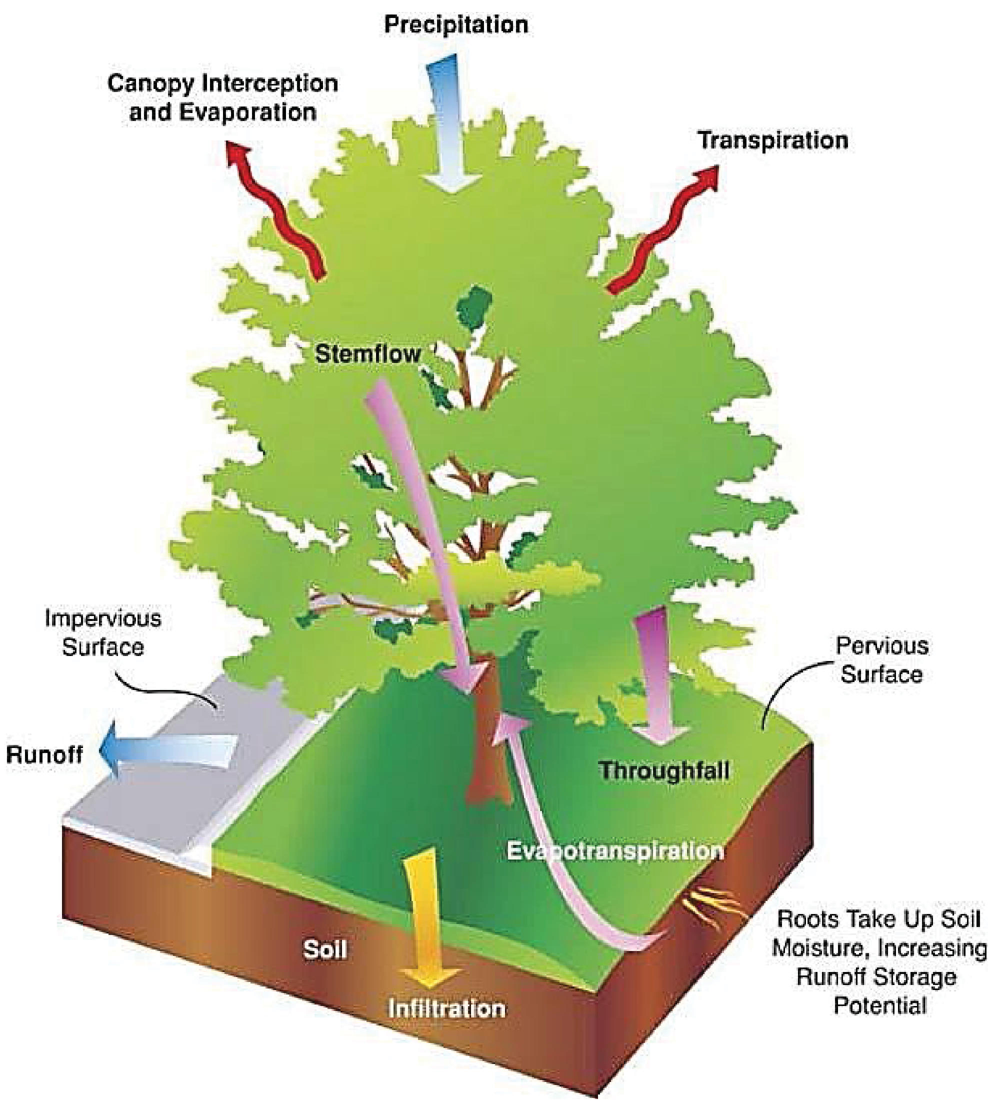


Currently, the combined land cover of forest and treed areas in the Nansemond River watershed is thirty percent (30%). This is the most predominant land cover type in the watershed, followed by wetlands that comprise twenty percent (20%) of the land cover. Therefore, is estimated that half of the overall land cover in the Nansemond River watershed is undisturbed forest, wetlands, or vegetation of some kind. Impervious surfaces and cultivated croplands, which generate the most pollutants, combine to equal twenty-four percent (24%) of the total land cover. Pasture/hay, grassland/turf, dwarf scrub and harvested/disturbed land cover generate lower amounts of pollutants than the impervious land cover and cultivated croplands; together they comprise fourteen percent (14%) of the land cover in the watershed.

Benefits of Trees

Forested and tree covered areas are of great benefit to the health of the Nansemond River watershed. Trees are integral to healthy landscapes and provide many benefits to the environment, wildlife, and people. Trees are also a critical element in maintaining water quality, which is discussed with Category 2 data.

The roots of trees provide incredible dividends; for example, they capture and absorb stormwater runoff and reduce the rate of runoff, which reduces the overall demand on stormwater management systems and reduces flooding. In doing so, trees help to reduce property damage during storm events. The tops or crowns of trees also provide another set of benefits; they help to reduce temperatures, save air conditioning costs, capture additional rainwater, and filter carbon dioxide from the air. According to the U.S. Forest Service, every dollar spent on planting and caring for a community tree yields benefits that are two to five times that investment. ("Trees Pay Us Back - Urban trees make a good investment", 2011)



Estimates for the amount of water a typical street tree can intercept in its crown range from 760 gallons to 4,000 gallons per tree per year, depending on the species and age. Trees within Suffolk's Growth Areas (the most urbanized areas) provide an estimated annual stormwater interception of 1.5 billion gallons. During a rainfall event of one inch, one acre of forest will release 750 gallons of runoff, while a parking lot will release 27,000 gallons; 36 times more runoff (PennState Extension). City-wide this makes an immense difference on the volume of stormwater runoff that must be captured and treated. In other words, investing in trees is a simple and effective strategy for cities to reduce their stormwater runoff and comply with requirements of the Municipal Separate Storm Sewer System (MS4).

The following tables show estimates of carbon and air pollution related benefits provided by the existing 11,850 acres of tree canopy within the City of Suffolk's Growth Areas. Tree cover acreage is calculated using the Virginia statewide land cover (1 meter resolution), and uses benefit assumptions from i-Tree Landscape.

Carbon Associated Benefits from Tree Canopy within the Growth Areas			
Carbon Storage	368,767.57	short tons	$ 51,347,195.96
Carbon Sequestration	14,042.08	tons/year	$ 1,955,219.38
CO2 Equivalent Storage	1,351,239.25	short tons	$ 51,347,091.68
CO2 Equivalent Sequestration	51,428.38	tons/year	$ 1,954,278.50

Air Pollution Benefits from Tree Canopy within the Growth Areas			
Carbon Monoxide (CO)	2,192.38	lbs/year	$ 983.70
Nitrogen Dioxide (NO2)	31,458.51	lbs/year	$ 6,178.21
Ground Level Ozone (O3)	524,647.11	lbs/year	$ 553,116.74
Particulate Matter (PM2.5)	17,999.93	lbs/year	$ 908,217.29
Sulfur Dioxide (SO2)	94,561.86	lbs/year	$ 5,588.67
Particulate Matter (PM10)	81,527.02	lbs/year	$ 186,902.04

When new development or redevelopment occurs, often many trees are removed and not replaced leading to overall tree canopy loss. Trees planted poorly, inappropriately, or not well managed can also lead to tree canopy losses. In addition, new trees that are planted take several years to reach the size of the preexisting trees. It has been said that for every 100 street trees planted, only 50 will survive 13-20 years (Roman, 2014). Existing trees are also lost to attrition, meaning that even if no land conversions occur, failure to replant trees as they age and die will lead to canopy loss over time. Cities, developers, and property owners can account for these factors by planting more trees than initially needed because not all will survive.

Tree canopy should be increased where possible, such that it does not conflict with power and utility lines or cause vehicular or pedestrian safety concerns. Urban trees should be given special consideration in terms of their placement, size, maintenance, need for sunlight, water, and tolerance to pollution. *The simple rule is right tree, right place.* The image on the right shows an example of a large tree that interferes with overhead power lines. This tree is not an appropriate street tree and should only be used internally on a site.

Trees also provide many economic benefits. Researchers have found that people shop longer and spend twelve percent (12%) more in tree-lined shopping districts, so trees in commercial areas support City revenues. When trees are not present, distances are perceived to be longer and destinations farther away, making people less inclined to walk than if streets and walkways are well treed (Wolf 2008). In addition, both residential and commercial property values increase and commercial spaces rent faster when mature trees are present. In Portland, Oregon, homes with street trees sold for $7,130 more, on average, and 1.7 days more quickly than similar homes without street trees. Furthermore, the Arbor Day Foundation found that the sale premium of having street trees was the same as adding 129 square feet of finished space.

The image below is an example of a new residential development that may have cleared more trees than necessary and stripped the landscape of its existing top soil and natural vegetation.

The image below is an example of a good street tree layout which allows adequate space for tree growth over time without interfering with roadways or sidewalks.

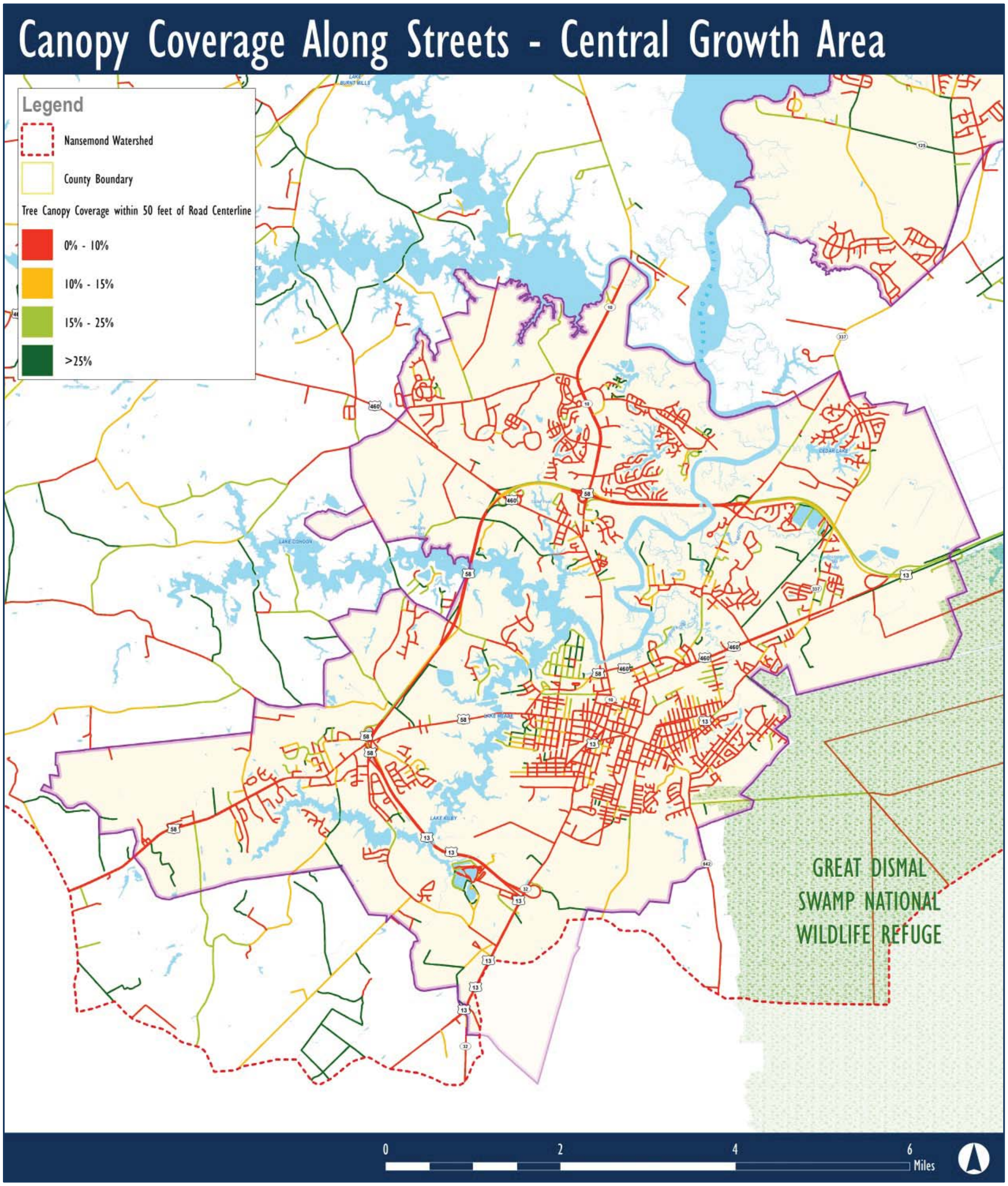
The two images below show segments of Suffolk's East Washington Street that lack street trees and contain high amounts of impervious surfaces. Drive aisles and off-street parking lots located between the principal building and the street should be minimized in urban environments because they detract from the quality of the streetscape and decrease walkability.

Possible Planting Area (PPA) maps overlay three layers of data: impervious area (excluding buildings), pervious area, and existing tree coverage. This type of map helps cities easily identify the best and worst treed streets as well as gap areas with no or little tree coverage. Communities are then able to find opportunities for tree planting projects and prioritize focus areas for tree maintenance or replanting. Cities are also able to set realistic goals using PPA data, such as increasing tree canopy five percent (5%) over the next ten (10) years or increasing tree canopy twenty percent (20%) along pedestrian-oriented streets.

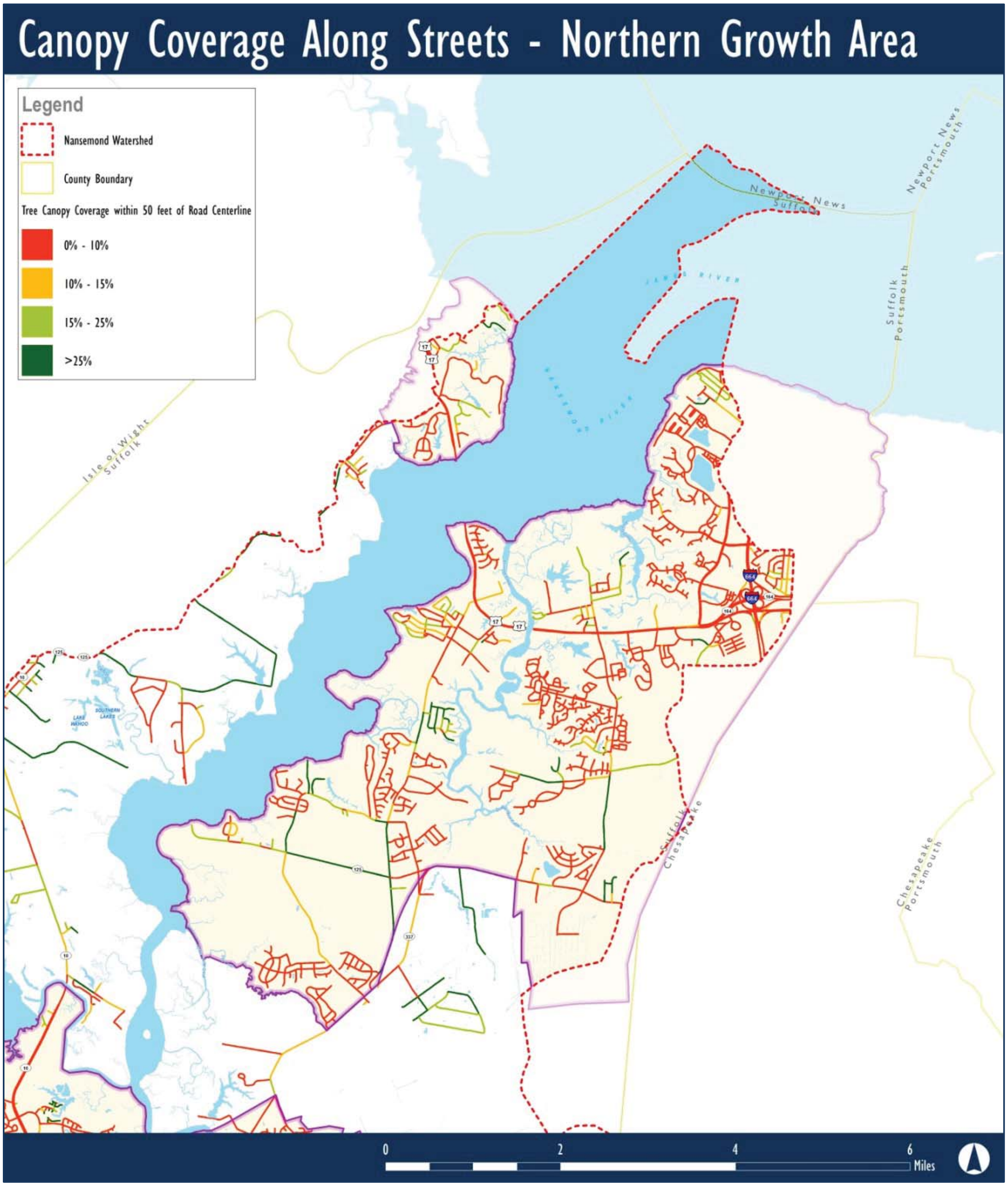
The Green Infrastructure Center conducted a PPA analysis for the Northern and Central Growth Areas in Suffolk; the map below shows a portion of the Central Growth Area. The Central Growth Area was found to have existing tree canopy coverage of twenty-eight percent (28%) compared to twenty-one percent (21%) for the Northern Growth Area. Due to the large size of the Growth Areas, a five percent (5%) increase in tree canopy coverage would require the installation of approximately 12,000 trees. (Please note: A buffer of ten (10) feet was used around buildings and tree canopy to allow adequate room for tree growth. Golf courses and railroad right-of-way were excluded and current land cover was estimated using one meter resolution land cover data produced by the state of Virginia in 2016.)

A PPA map only estimates areas that are feasible to plant trees; it is not a suitability map. Therefore, an area identified as a feasible place to plant a tree may not be suitable due to low power lines or underground utilities. For this reason, it is imperative that PPA maps are field checked for potential conflicts or obstructions. In addition, the city must compare their tree planting plan with future utility and roadway improvements to ensure that newly planted trees will prosper in their environment and not pose problems over time.

The data produced by this study is helpful in evaluating existing tree canopy coverage in targeted areas, in this case that found within 50 feet of the center of streets in Suffolk's Central and Northern Growth Areas. The data reveals that the majority of streets within the Central Growth Area have a tree coverage of less than ten percent (10%). This is an indication of dense development and large amounts of impervious land cover in the downtown area. Together with the Possible Planting Area analysis, this data can be used to create long-term tree canopy goals for the watershed. There is substantial room for improvement; however, once the City takes into account the conflicts with existing infrastructure as mentioned with the PPA map, the potential for improved tree canopy is reduced.



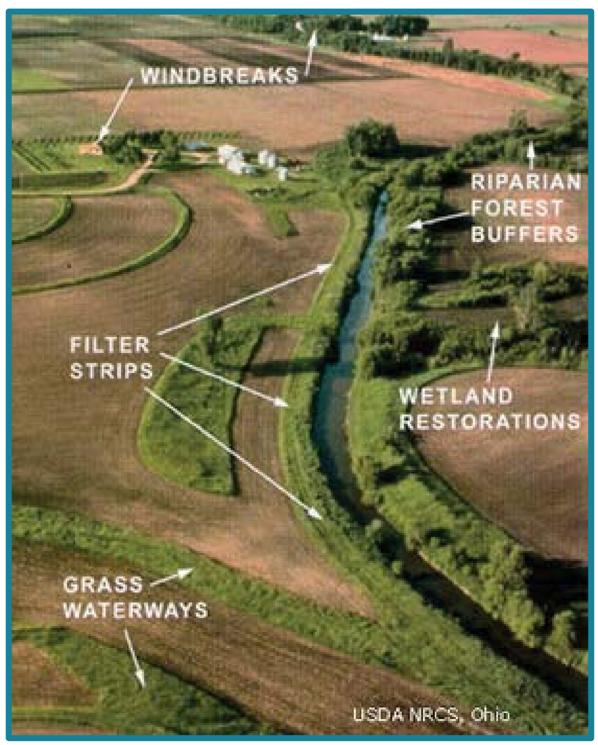
The Northern Growth Area also lacks good street tree coverage even though this area is more suburban and less impervious than the historic downtown. The Northern Growth Area has experienced a lot of development in recent years. The data reveals that perhaps there have been missed opportunities in increasing the street tree canopy as part of new development projects. Improving tree canopy along streets not only helps to support and connect habitat for birds, insects, and small animals, it also provides many benefits with regard to stormwater management.



Category 2: Water Quality

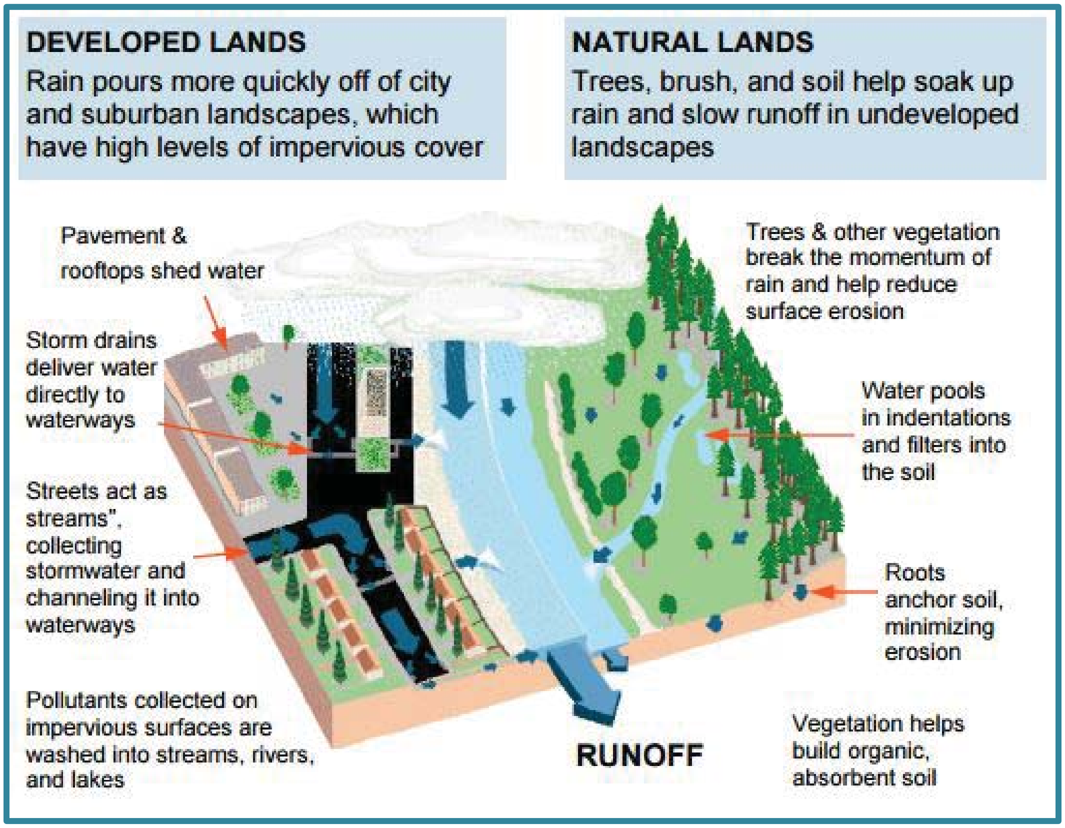
Water quality has direct health impacts on aquatic species and human drinking water. At certain levels of urban development and related imperviousness, aquatic life begins to decline. The rate of decline is affected by factors such as land cover, lot sizes, and land use types, as well as the density and location of impervious surfaces within a watershed. Excessive urban runoff is comprised of non-point source pollution, such as sediment, oil, metals, lawn chemicals, and pet waste. Too much nitrogen and phosphorus can cause algaeblooms that block sunlight to underwater grasses. As blooms decompose they create "dead zones" where dissolved oxygen levels are too low to sustain fish, resulting in a loss of aquatic species. Thus the more that localities and the public can reduce pollutants entering a waterbody, the more the health of our ecosystem and community will improve.

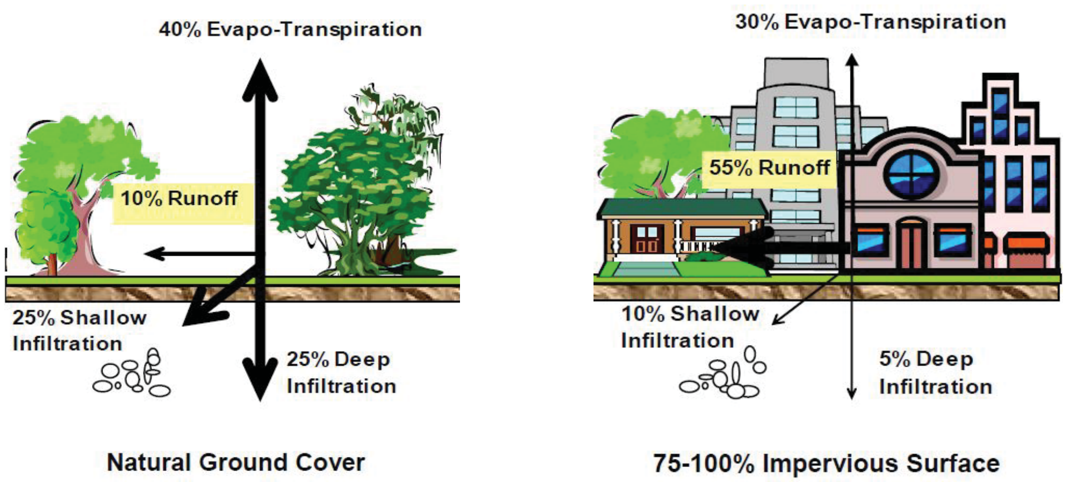
Trash also significantly impacts water quality, particularly in developed areas where it frequently makes its way into streams, creeks, rivers, and eventually the ocean, as rain washes it into gutters and storm drains. Trash is a significant pollutant that adversely affects aquatic life, wildlife, and public health. Public recycling stations that are well marked and easily accessible help to encourage residents to recycle and deposit trash appropriately in an effort to maintain and improve water quality.



A key determinant of stream health, and therefore water quality, is how well buffered steams are with natural vegetation. A woody vegetated buffer of 100 feet adjacent to streams can remove more than ninety percent (90%) of the nitrogen, phosphorus, and sediment from overland runoff. If stormwater pipes pass beneath the buffer and discharge to the stream directly, then much of the buffer benefits for mitigating polluted runoff are lost. A general rule of thumb is that impacts to aquatic life tend to be seen even at impervious levels just above 10% (Schueler, 2003). As the rate of impervious reaches 25%, stream habitat quality is degraded. Vegetated buffers, filter strips, and forested areas provide a means to help remove many harmful pesticides and pathogens from stormwater runoff to protect water quality and marine life. These buffers also double as habitat corridors.

Impervious surfaces and urban stormwater systems increase runoff to streams and rivers. Natural groundcover allows 25% of rain to infiltrate into the aquifer, another quarter is absorbed by shallow infiltration, and 40% evapo-transpires, which leaves only 10% of the rain to become runoff. In highly urbanized areas, over half of rainfall becomes surface runoff, and deep infiltration is only a fraction of what it was naturally. The water table drops when deep infiltration decreases, which reduces groundwater for wetlands, riparian vegetation, wells, and other uses (Ruby, "How Urbanization Affects the Water Cycle").





Green Infrastructure Inspired Stormwater Management Techniques

There are many examples of green infrastructure inspired stormwater management techniques that aim to either reduce stormwater quantity, improve stormwater quality, or both. A reduction in the quantity of runoff results in an increase in water quality because fewer pollutants are able to enter the stormwater management system, and it also allows the system to work more efficiently.

Rain gardens, such as the one shown below located in a school drop-off loop, allow runoff to slowly infiltrate over several hours or a couple of days in order to filter pollutants and settle sediment before the water seeps back into the groundwater table. Rain gardens come in a variety of forms and sizes and they can be utilized in many locations; cul-de-sacs, for example, provide excellent opportunities for rain gardens because they take advantage of unused impervious area. The key to any rain garden located adjacent to impervious area is to include several curb cuts that allow the water to access the vegetated area.

A flow-through parking island planter, shown below on the right, can be utilized to slow the rate of stormwater runoff as well as provide a collection point for water to infiltrate and for contaminants to be removed by the plants and rocks. (“Green Infrastructure,” 2016)

The image below on the left shows a parking lot along North Main Street that is devoid of any vegetation that would treat runoff. This puts significantly more pressure on the City’s stormwater management system, especially during flash floods.

“Green” streets, shown below on the left, use a variety of methods to capture stormwater while supporting pedestrians and cyclists. Urban rain gardens, which are shown below on the right, work well at capturing stormwater in space-limited areas.

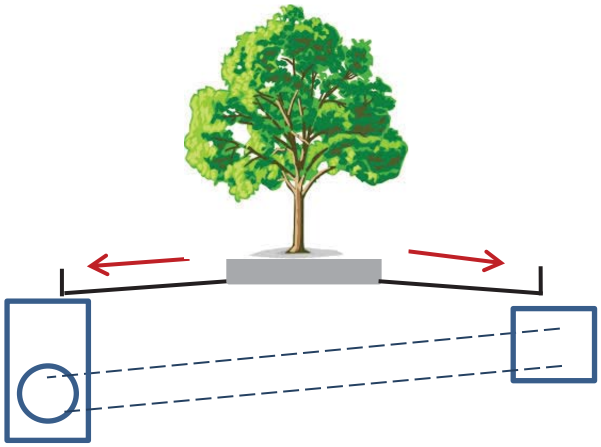
A comparison between traditional road drainage design and green infrastructure based road design shows the potential for improved stormwater management and infiltration that can be achieved. Additionally, less hardscape may be needed to implement alterative designs.

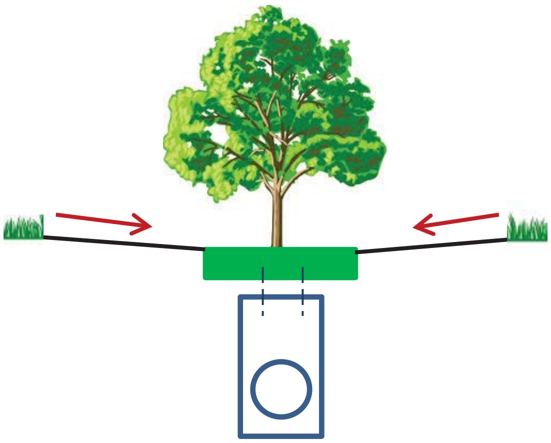
<u>Traditional road drainage design:</u>

- Stormwater drains to both sides of the street with the highest point being in the center of the road.
- Curb inlets are located on both sides.
- Cross pipes transport water from the curb inlet on one side to the main pipe on the opposite side.
- More infrastructure may be used to convey stormwater.
- Maintenance operations may be more expensive and may cause road closures.

<u>Green infrastructure road drainage design:</u>

- Stormwater drains to the center of the street with the highest points being on the outside travel lanes.
- Curb inlets are not used.
- Fewer cross pipes are needed.
- Less infrastructure may be used compared to the traditional road drainage design.
- Maintenance operations may be less intensive and may not cause road closures if the median is wide enough.





Plant Selection and BMP Design Tips

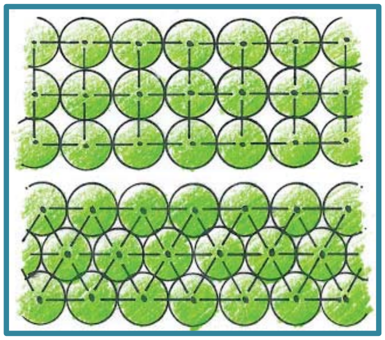
Plant selection and design tips for best management practices (BMPs) are simple, yet extremely effective in helping to improve water quality and reduce the volume of runoff entering stormwater management systems. With a little adjustment and adaptation, these techniques can be utilized on almost all types of property and on a variety of scales (Andruczyk, 2015).

Considerations for plant selection:

- Choose plants tolerant of both occasional flooding as well as dry periods.
- Avoid annual plants in BMPs because they require high maintenance and generate lots of debris.
- Choose noninvasive plants that are well adapted to the local environment with regard to sunlight, temperature, winds, rainfall and salinity of water.
- Choose a mixture of species. A good rule of thumb is one plant species for every 10 to 20 square feet.
- Choose plants for vertical layering/canopy layering. This also creates root layering for better infiltration and soil stabilization. Additionally, if one species dies, the BMP will still be able to serve its purpose.
- Consider selecting plants that deter or exclude animals such as geese from entering the BMP.

Triangular planting pattern vs. grid pattern:

- The triangular planting pattern allows for higher plant density and smaller gaps which helps to stabilize the soil and mulch.
- If one plant dies in the triangular pattern it is less obvious or impactful than in the grid pattern. Since water is known to travel the path of least resistance, the grid pattern creates water channels where water can escape rather than be absorbed by the plants.

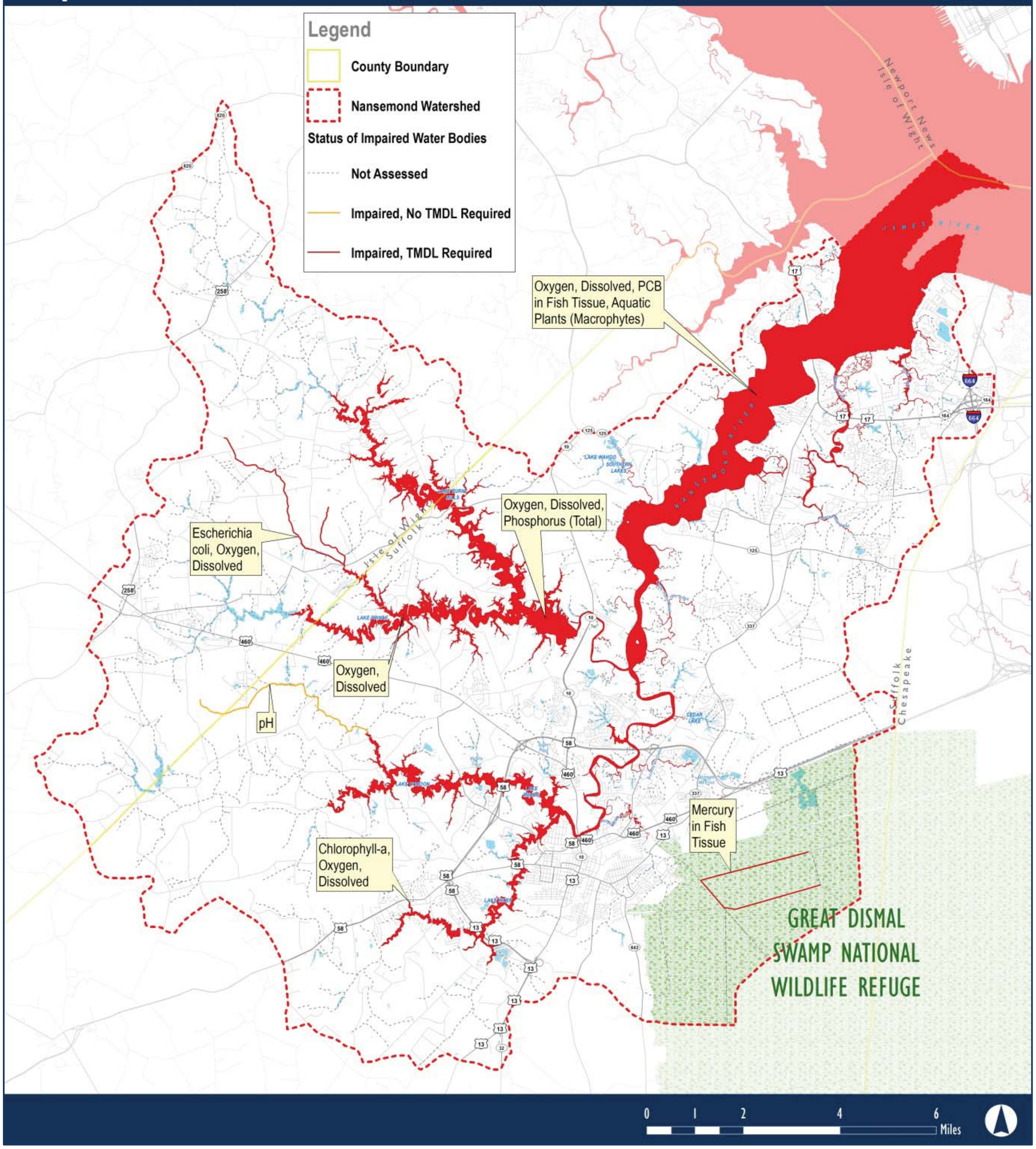


("Garden Thymes", 2013)

Importance of plant density:

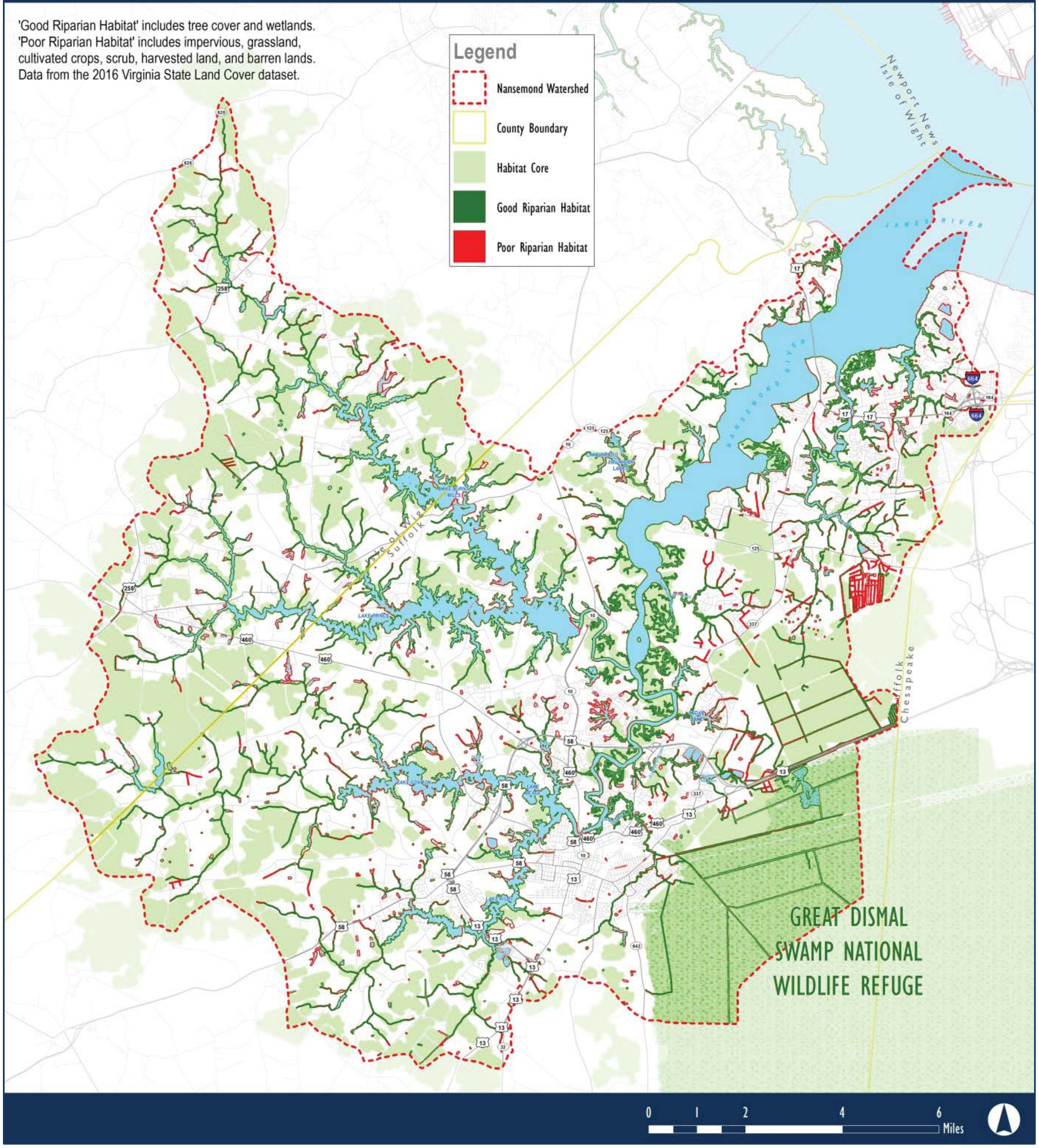
- Plant density is one of the most important aspects of a BMP yet one of the first things to go once budgets become limited. A successful BMP depends on thick plant cover.
- The highest plant density should be at the top of the slope in order to slow water down and spread it out for better infiltration. It also minimizes erosion.

Impaired Waters



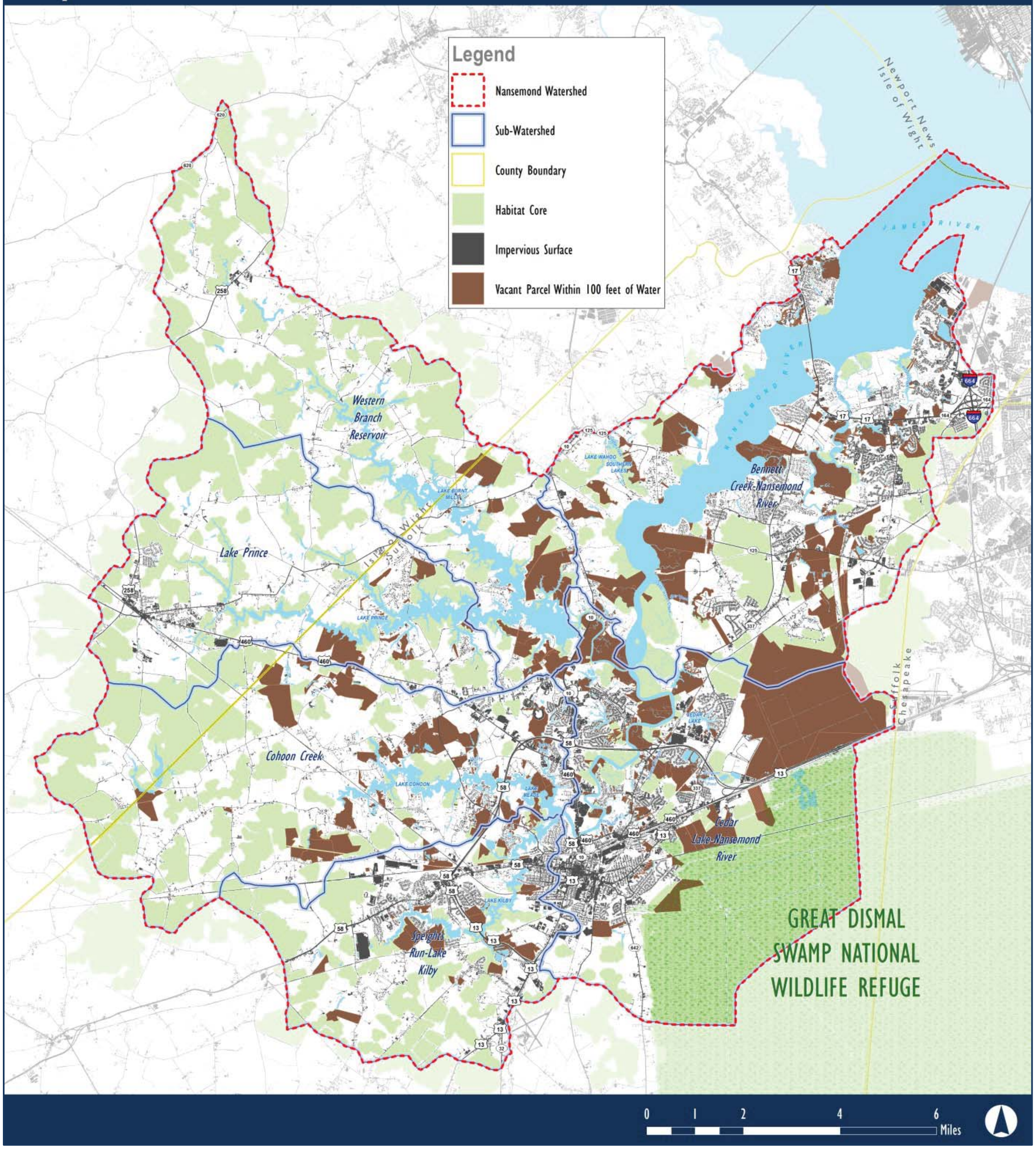
An ‘impaired’ stream, as designated by the Virginia Department of Environmental Quality, is considered to be too polluted or otherwise degraded to meet the water quality standards set by the state. Under section 303(d) of the Clean Water Act, the law requires the jurisdictions to establish priority rankings and develop Total Maximum Daily Loads (TMDL) for these waters. A TMDL is a calculation amount of a pollutant that a water body can receive and still safely meet water quality standards. The causes of impairment are listed and help identify what pollutants are most prevalent in each water body. This also helps to reinforce the importance of green infrastructure investments to improve water quality and reach TMDL goals.

Riparian Buffer Status



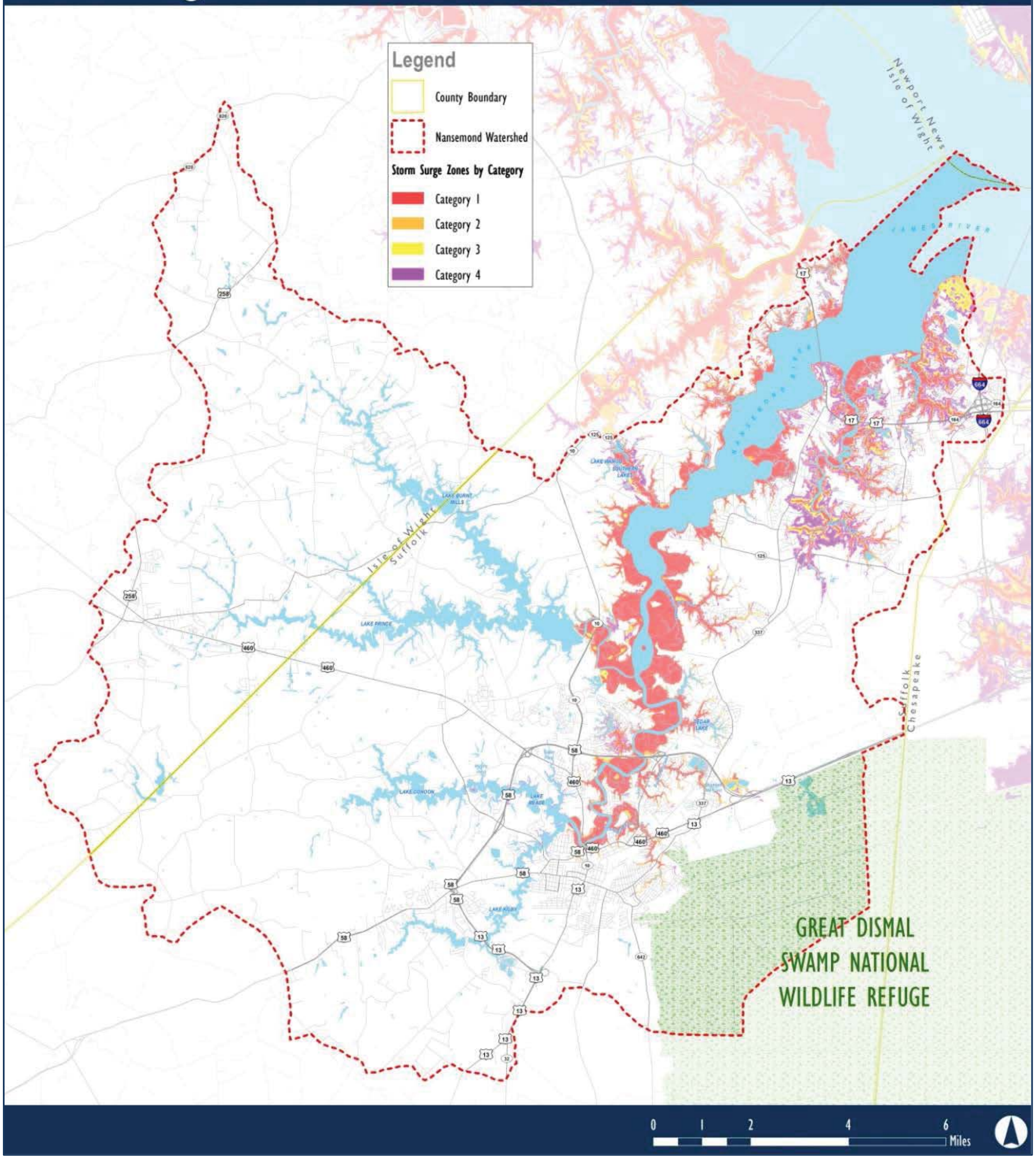
Riparian buffers (tree cover and wetlands) included in this dataset are those that exist within 100 feet of surface water, which is classified as the Resource Protection Area. Good riparian buffers are extremely important for good water quality because they filter pollutants and sediment before it reaches surface water. They also help to regulate the temperature of surface water and they support a diverse habitat. In addition, riparian buffers absorb wave energy and reduce flooding impacts compared to structural systems such as rip rap and bulkheads. It is interesting to note that, although the data indicates that the majority of riparian buffers in the Nansemond watershed are in good status, surface water impairments are still prevalent.

Impervious Surfaces and Vacant Parcels Near Water



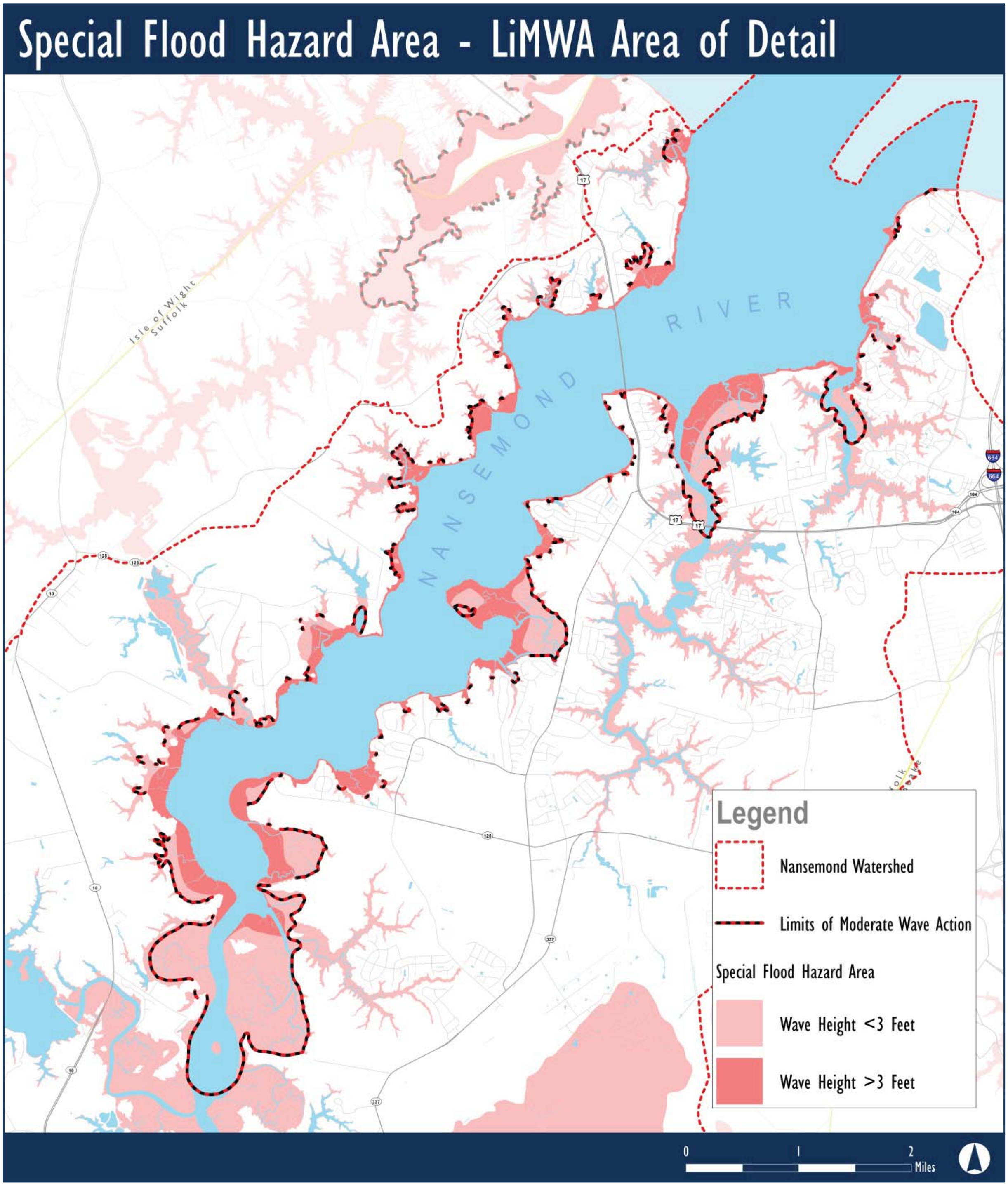
Parcels that are located in close proximity to the Nansemond River and its tributaries can impact water quality to a large degree, either positively or negatively. Parcels within 100 feet as identified by the data should receive careful consideration and planning as appropriate. For instance, consideration may be given to establishing more stringent regulations for impervious area, landscaping, and open space requirements on properties located within close proximity to waterways. Vacant parcels also provide opportunities for improving tree canopy and habitat cores, as well as incentivizing low impact development.

Storm Surge



Storm surge zones correlate to hurricane categories, which are determined by the National Hurricane Center. Hurricanes are categorized based on their wind speeds: 1 is the lowest and 4 has the fastest, most hazardous wind speeds. The data indicates that category 1 storm surge is estimated to impact a significant amount of land area on both sides of the Nansemond River. Overall, the Northern Growth Area is the most susceptible area to storm surge impacts, although the developed area to the north of the Kimberly Bridge on North Main Street is also particularly vulnerable.

Localities should be concerned with storm surge impacts not only because of potential property damage, but also because of channel and bank scouring, which releases sediments that may smother aquatic life and reduce stream depth. For these reasons, development may not be suitable within the category 1 storm surge zone; these areas may be better utilized for habitat cores and large riparian buffers that protect the water from pollutants.



The map above shows a section of the Special Flood Hazard Area (SFHA), which is defined by FEMA as the area that will be inundated by a flood event having a one percent (1%) chance of being equaled or exceeded in any given year.

The one percent (1%) annual chance of flood is also referred to as the base flood or 100 year flood. The flood zone is divided into areas that are subject to wave action of greater than three (3) feet and less than three (3) feet. Areas located outside of the limit of moderate wave action but still within the flood zone will experience flooding during a 100 year storm event; however, they will not be subject to wave action. This data can be extremely valuable in guiding future land use plans and development regulations.

Flood Hazard Mitigation

The Nansemond River drops only about 65 feet in elevation from the headwaters to the mouth, where it empties into the James River. Low-lying areas near the river are very susceptible to hazards associated with storm surges and flooding. When the river floods into developed areas, large volumes of untreated pollutants enter the watershed and degrade the quality of our drinking water, erode the river's edge, and cause "dead-zones" for aquatic life. Floods cause immense property damage, damage to utilities, and road and bridge failures. Economically, floods cause temporary or permanent business closings, government office closings, and school closings. Worst of all, floods may cause a loss of life. These threats must be taken seriously as severe storms are not a matter of if, but when they will impact our community.

Hurricane Matthew, which occurred on October 10, 2016, severely inundated the North Main Street area of the City of Suffolk, north of the Kimberly Bridge and Constant's Wharf. Several properties were impacted by the flood waters and large quantities of untreated oil and pollutants entered the watershed. This area is subject to regular flooding events as well, often blocking the road and impacting surrounding businesses.

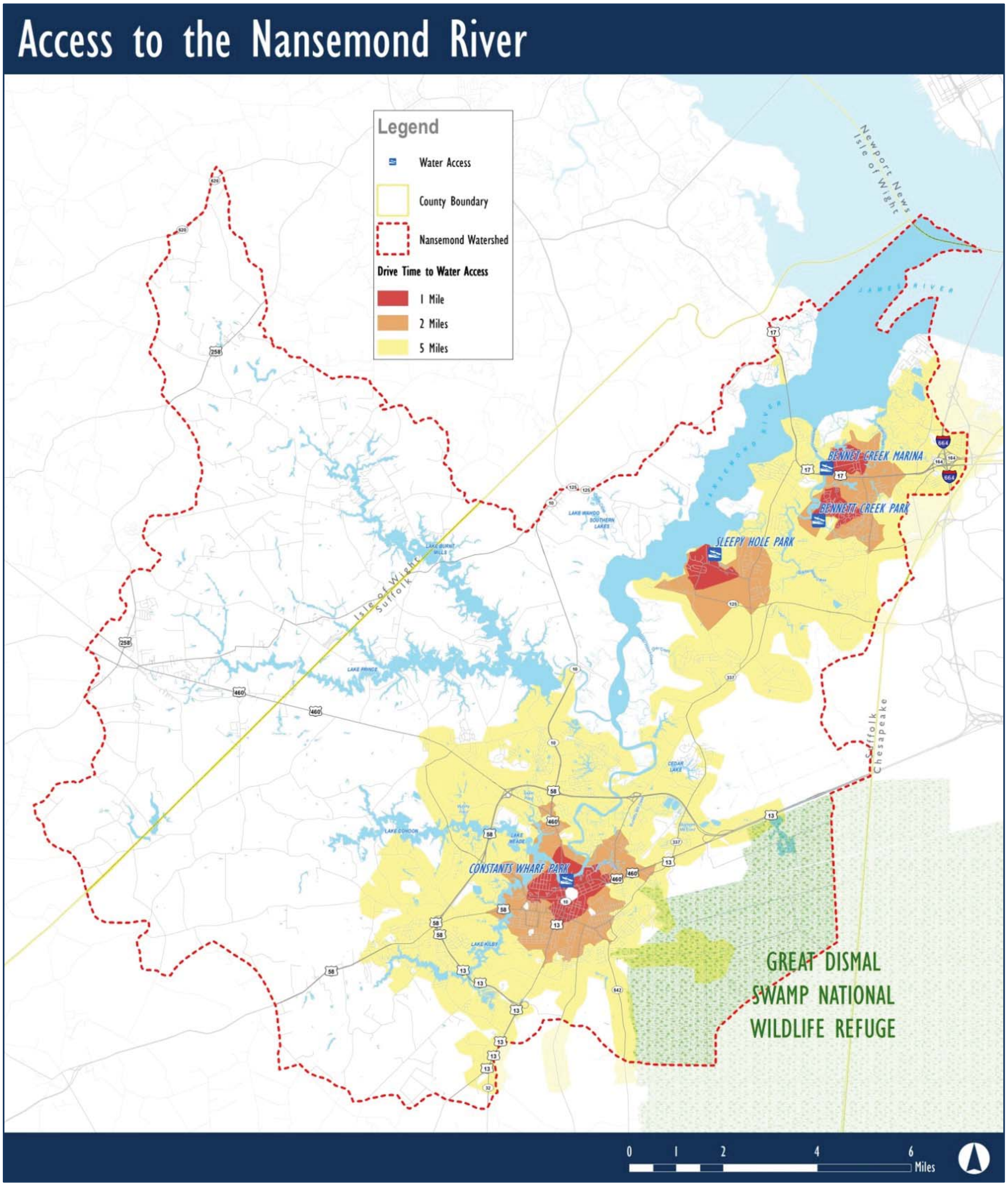
Flood and storm surge data can be used by localities to assess the compatibility of existing zoning districts, permitted land uses, buildable areas, setbacks, and other development regulations and standards with flood-prone areas. Ultimately, localities should aspire to design with nature, not against it, in order to protect citizens, businesses, property, and infrastructure from the impacts of flooding and storm surge events. Opportunities to reclaim developed areas highly susceptible to storm surge and flooding and to reestablish natural areas as part of a green infrastructure network may also be identified through the use of this data.

Category 3: Parks, Trails, and Access to Nature

Equitable distribution of parks and trails are a fundamental component of a healthy community. Parks provide numerous benefits; they are destinations for play and exercise, they help to reduce stress, improve mood, encourage social interaction and community building, increase one's appreciation of nature, and help to establish a sense of place. They are especially important in urban areas which typically lack nature, open space, abundant light, and great air quality. According to a publication by the National Recreation and Park Association, park proximity plays an important role in promoting higher levels of park use and physical activity amongst diverse populations, particularly for youth. ("Parks & Recreation in Underserved Areas: A Public Health Perspective")

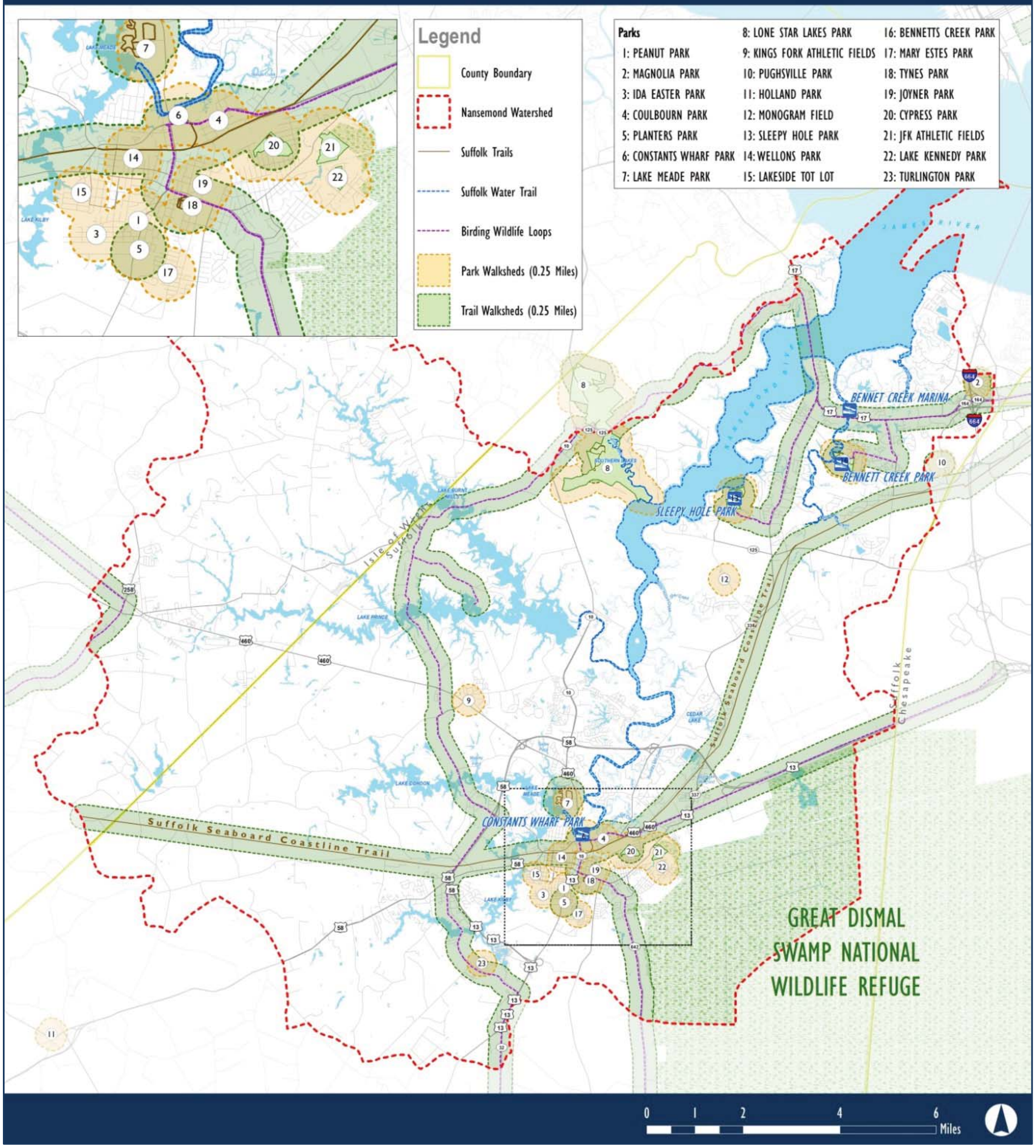
The City of Suffolk supports sixteen parks that are open from sunrise to sunset daily. One regional park exists in Suffolk, Lone Star Lakes, which features eleven lakes for fresh water fishing among numerous other amenities. There are six community parks: Bennett's Creek, Sleepy Hole, Cypress, Lake Kennedy, Lake Meade and Constant's Wharf Park and Marina. Lake Meade Park provides valuable recreational opportunities in close proximity to the downtown core; it consists of 69 acres and the largest children's playground in the city. Collectively, these parks provide a diversity of recreational opportunities including trails for walking, jogging and biking, basketball courts, playgrounds, activity fields, picnic areas, disc golf, archery, horseshoe pits, dog parks, skate parks, tennis courts, canoe/kayak access, and fishing.

Several major improvements to park and trail facilities have been made in the past two years, including the completion of a 2.3 mile stretch of the Suffolk Seaboard Coastline Trail and the installation of two new canoe/kayak launches at Sleepy Hole Park and Constant's Wharf Park and Marina. This significantly increased the public water access points along the Nansemond River. A neighborhood level park, Boston Park, which features a children's playground also opened. Beginning in 2017, the City is undertaking its first Bicycle and Pedestrian Master Plan to focus on potential roadway, right-of-way, and trail improvements to increase bike ridership and encourage alternative transportation in the Northern and Central Growth Areas.



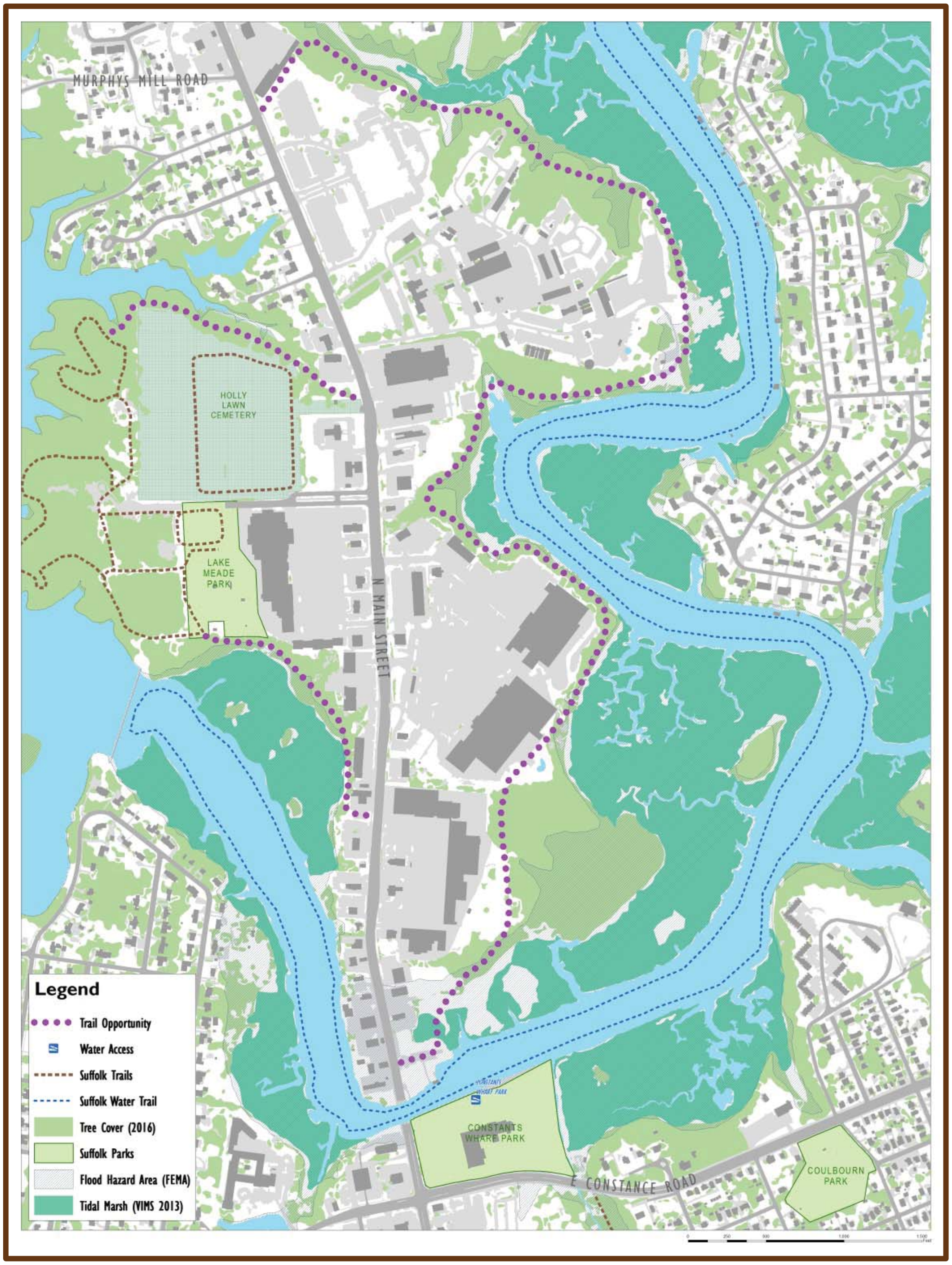
All of the public water access points on the Nansemond River are located in the northeastern or central areas of Suffolk. Although this is where the majority of the population and developed areas are located, more access points should be created in the western portion of the watershed to improve equity for all. The City may consider establishing a long-term goal to provide public water access within a five (5) mile driving distance of all neighborhoods within the Nansemond River watershed, as indicated by the yellow areas on the map.

Access to the Nansemond River



This dataset includes all twenty-three (23) parks and trails in Suffolk, not just those located in close proximity to the river's edge. A quarter-mile buffer or walkshed, shown in orange, was applied to each data point in order to show which park and trail facilities are easily accessible by a five (5) minute walk. As was the case with water access, the data shows that parks are concentrated in the Northern and Central Growth Areas of Suffolk; trails however, appear to be more evenly dispersed throughout the landscape. Since the downtown area has a strong presence of park facilities within quick walking access of most residents, the City should consider adding new facilities in other areas of the watershed.

During the final Green Infrastructure Committee meeting held in January 2017, the Green Infrastructure Center shared a conceptual map for a trail opportunity in the North Main Street/Constant's Wharf area of the City of Suffolk. The concept was created in response to public feedback received from the December 2016 public forum. This conceptual trail design represents one opportunity to fulfill all four green infrastructure goals and also demonstrates the type of projects the City could develop in the future using the data from this study.



Category 4: Culture and Heritage

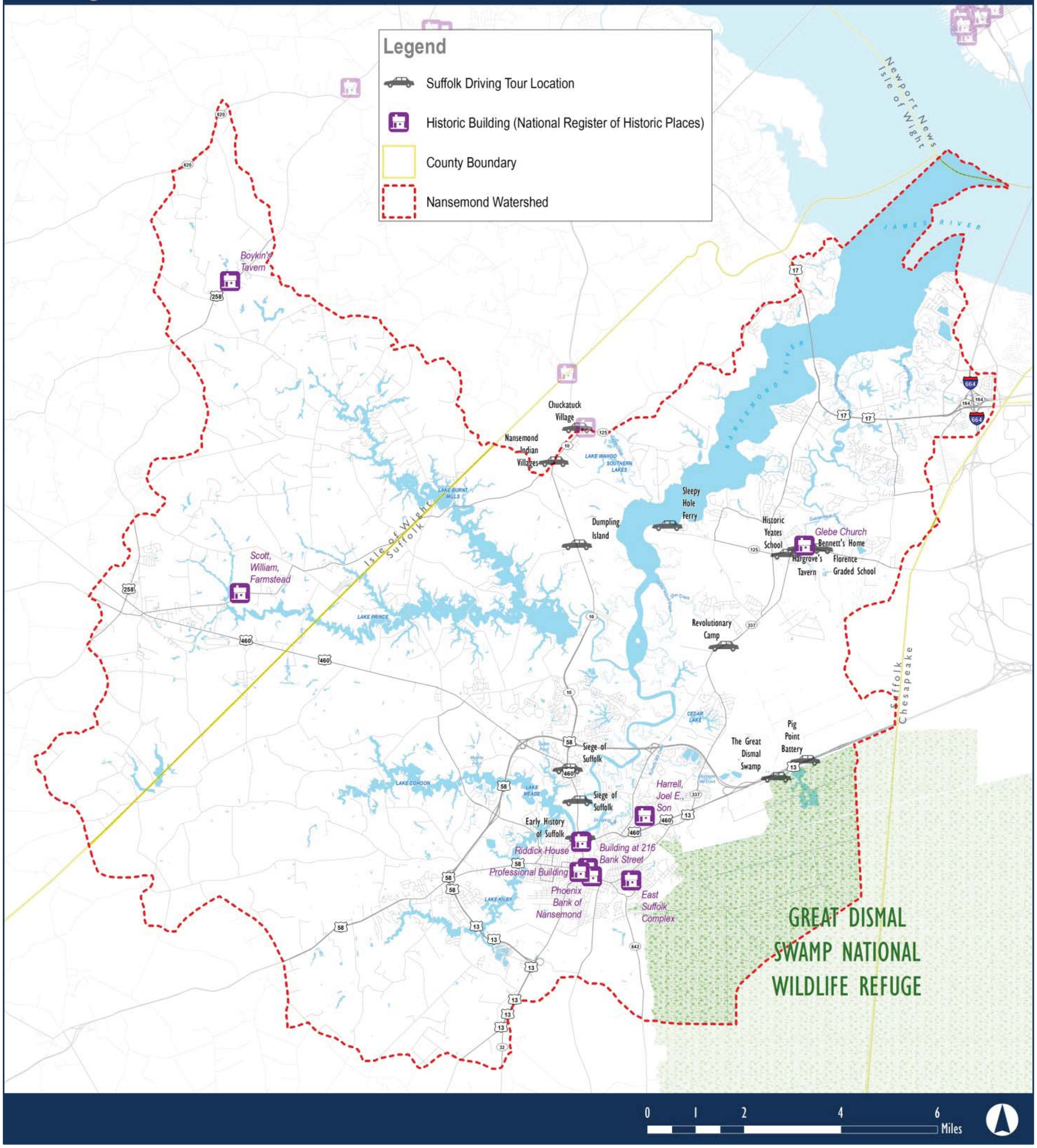
The Nansemond River watershed was inhabited by Native Americans before arrival of the English colonists in the 17th century. The town of Suffolk began on its banks, near Constant's Wharf, a site named after John Constant, who settled along the Nansemond River to establish his home, wharf, and tobacco warehouses in the 1720s. In 1974, Suffolk, Nansemond County, and the unincorporated towns of Holland and Whaleyville, consolidated to become the present-day City of Suffolk, which also includes the villages of Driver, Chuckatuck and Eclipse. Suffolk evolved as an agricultural hub for the Hampton Roads region as goods could be transported via waterways and railroads to Norfolk, Portsmouth, Petersburg, Richmond, and Roanoke.

In 1912, an Italian immigrant named Amedeo Obici opened Planters Nut and Chocolate Company; ever since, Suffolk has been recognized as the peanut capital of Virginia. This heritage is celebrated annually each fall during Peanut Fest which attracts over 125,000 people. Recently, the City has also been recognized for its growing caffeine industry as it is home to Unilever, Lipton Tea, Massimo Zanetti, Smuckers, and Peet's Coffee (under construction).

Since much of Suffolk's success and identity is attributed to the quality of its farms, landscapes, and waterways, these features must be preserved and protected in order for the community to retain its sense of place.

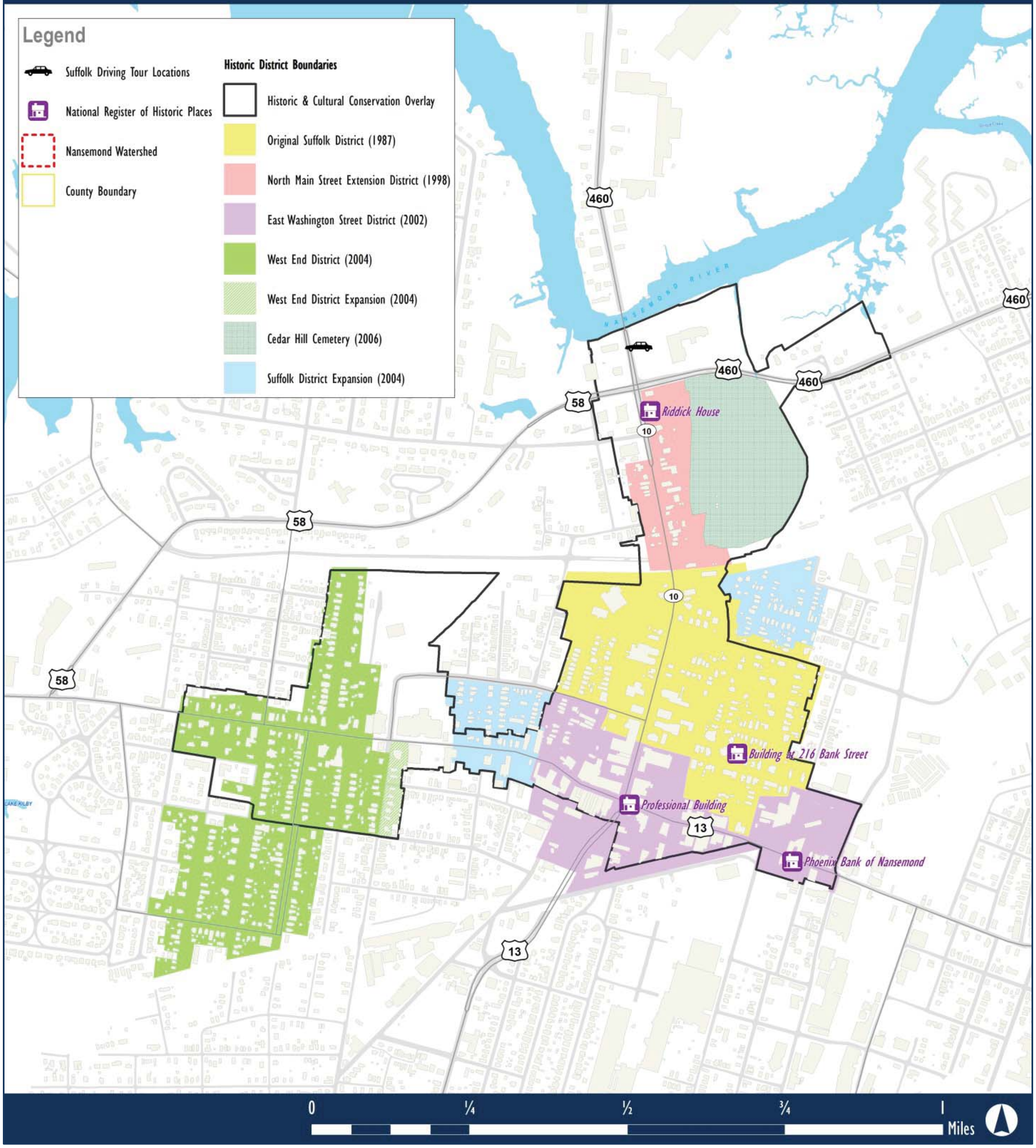
The community values historic and cultural structures in downtown, such as the Suffolk Center for the Cultural Arts, Riddick's Folly, and the former courthouse building that now serves as the Suffolk Visitors Center. The City has been working for many decades to recognize and maintain its heritage through preservation of its historic resources. In 1987, the Historic Conservation Overlay District was established around downtown. Approximately ten years later, Suffolk became a Certified Local Government, which provided the City with greater resources to manage maintenance, modifications, and identification of historic assets. The Historic Landmarks Commission oversees all exterior changes to properties within the Historic District to verify that the proposed changes comply with the Historic District Design Guidelines. By preserving the unique character of the downtown core, Suffolk can retain and attract residents and businesses. An additional economic benefit of a strong historic district is that it helps to attract heritage tourists which spend on average about 2.5 times more than all other tourists.

Designated Historic Assets



The purple icons shown above represent structures, sites, or objects that are part of the National Register of Historic Places, which was established in 1966 and is managed by the National Park Service. Sites that are part of the Suffolk Driving Tour are included on this map because they have also been deemed to be historically significant to the community.

Downtown Historic Resources

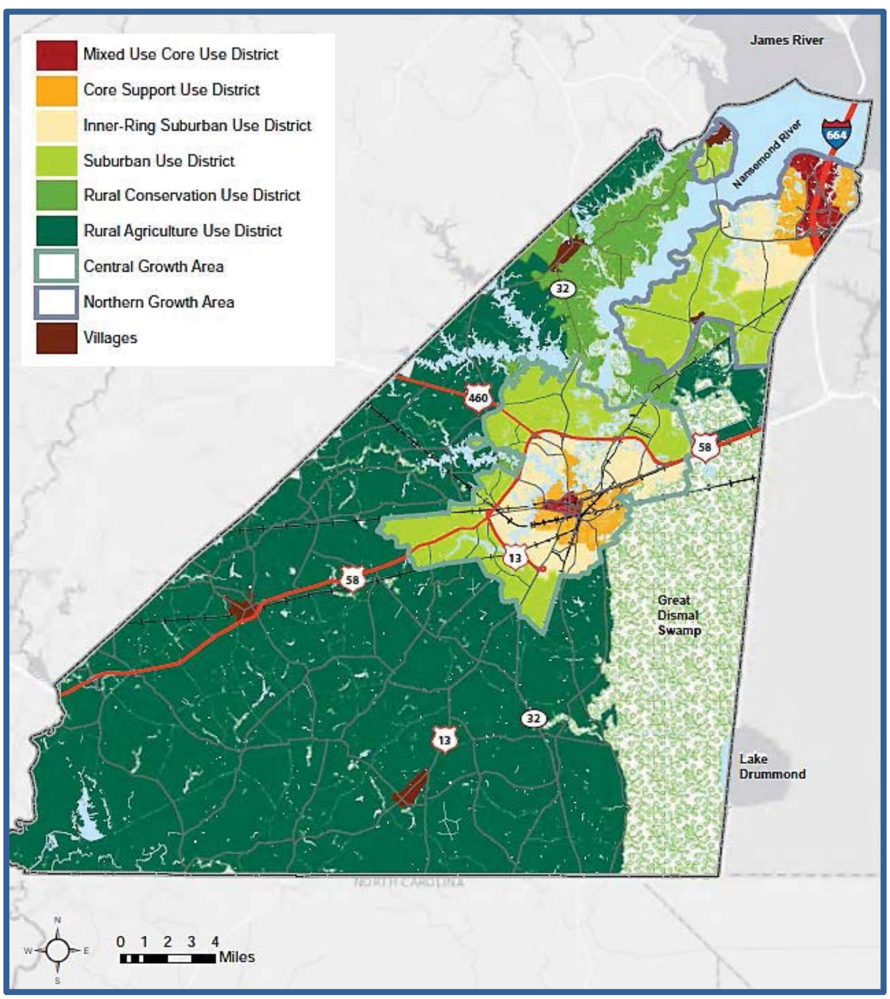


Downtown Suffolk encompasses seven historic districts listed on the National Register of Historic Places and includes properties that date as far back as the 18th Century. The Suffolk Historic Conservation Overlay District is a locally designated district comprised of portions of the seven individual historic districts. It provides for preservation of significant properties and is overseen by the Historic Landmarks Commission. The City should take into account the location and significance of existing cultural and historic resources before developing plans for new green infrastructure.

DEVELOPMENT PRESSURE

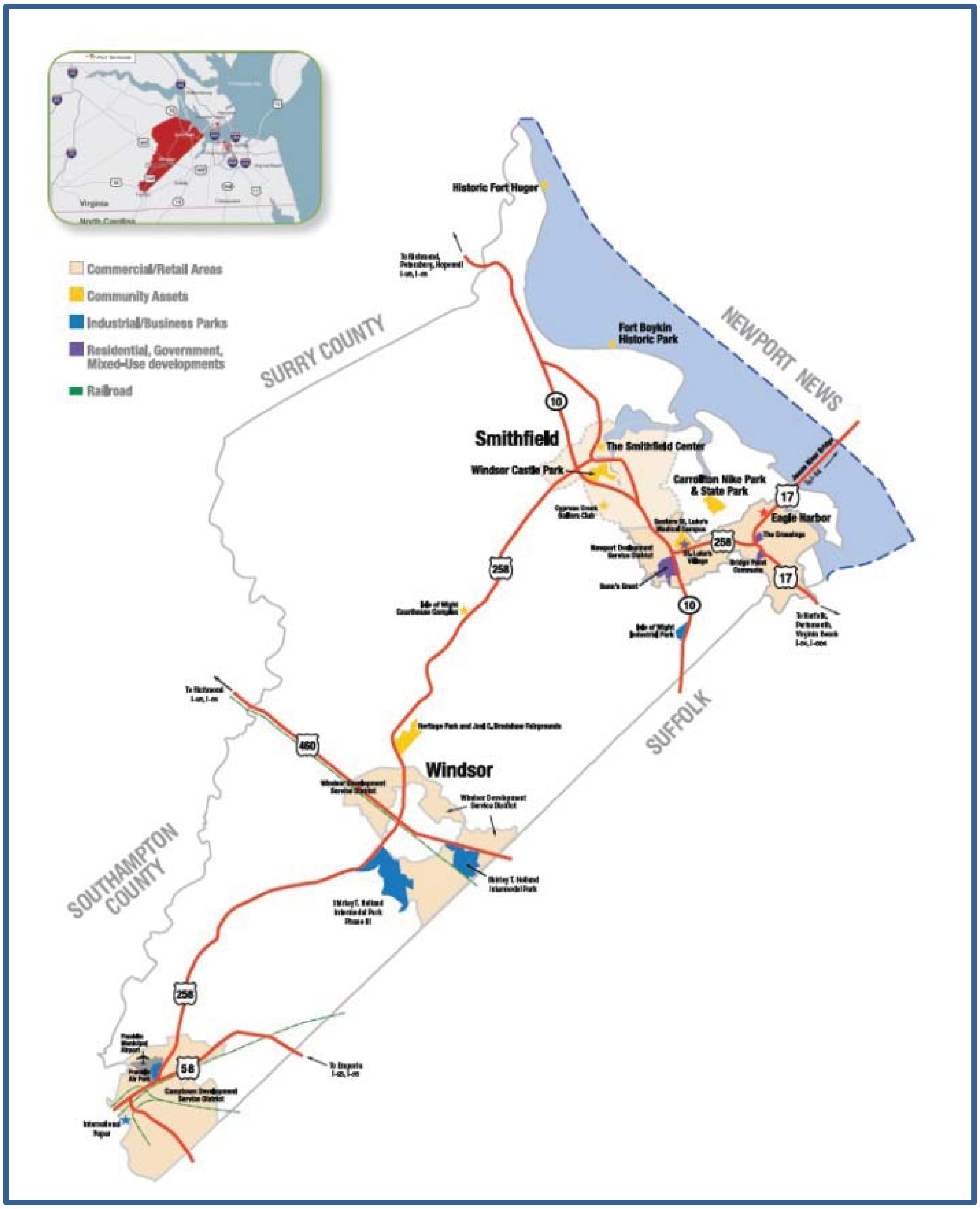
Land development is one of the primary causes of habitat loss; therefore, it is imperative that a locality is familiar with their past and current land development trends in order to anticipate what future development may have in store and where is it most likely to take place. While there are dozens of factors that affect development pressure, one the most significant factors are local regulatory measures, including but not limited to: zoning, building, and subdivision regulations, as well as property taxes.

In order to aid in the preservation and conservation of vital environmental, agricultural, and historical features, both the City of Suffolk and Isle of Wight use growth management strategies that designate areas where development should be concentrated. The City of Suffolk has embraced a focused growth strategy since 1998, when it was first adopted as part of the Comprehensive Plan. This strategy has been revised and refined most recently in the 2035 Comprehensive Plan. The City has prioritized and concentrated development in Northern Suffolk, adjacent to Interstate 664, and Central Suffolk, around the historic downtown, in order to maximize the use of existing infrastructure and preserve agricultural and forested lands.

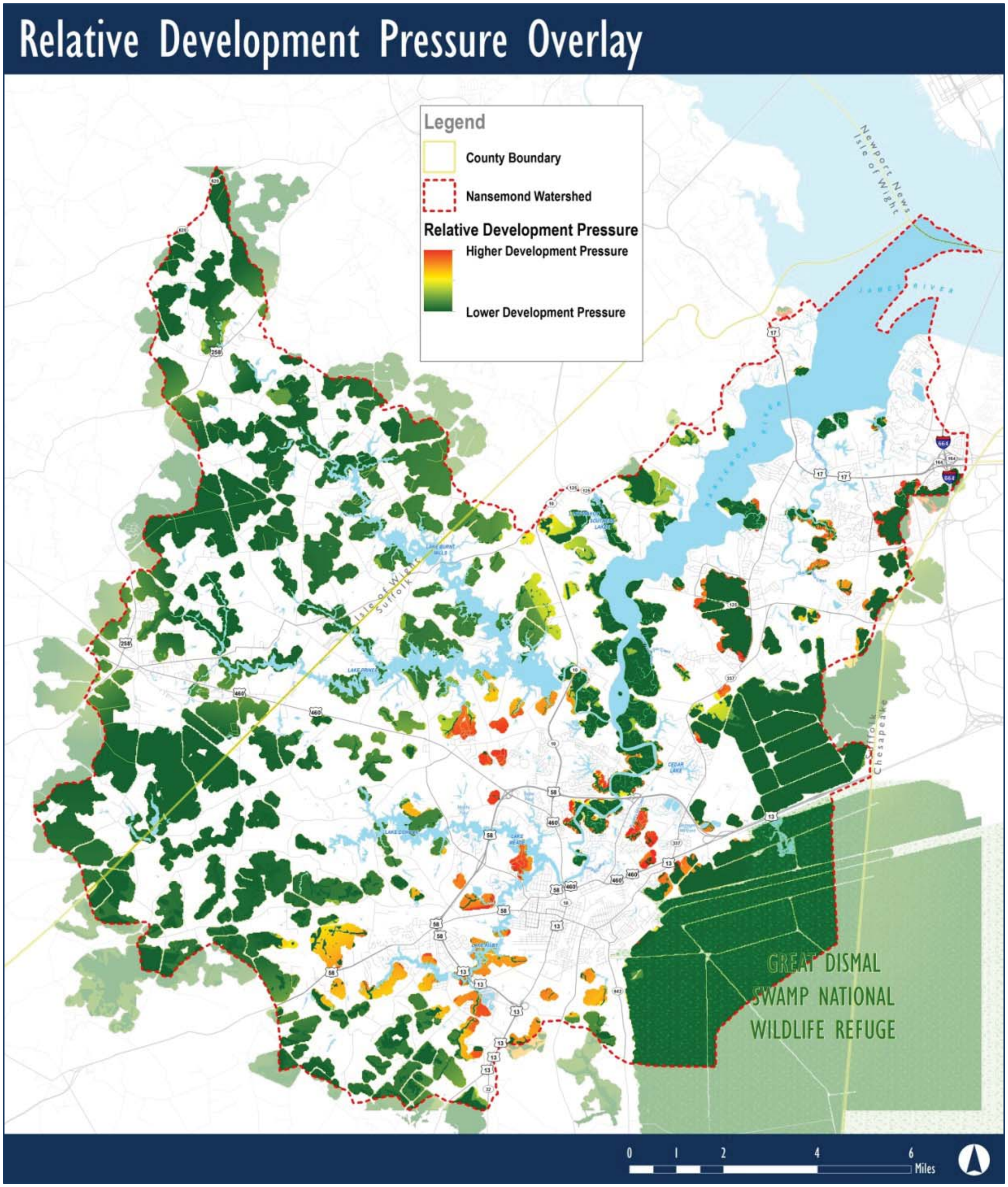


Both of the designated Growth Areas in the City of Suffolk are located near vital waterways, many of which are now impaired and in need of protection and restoration.

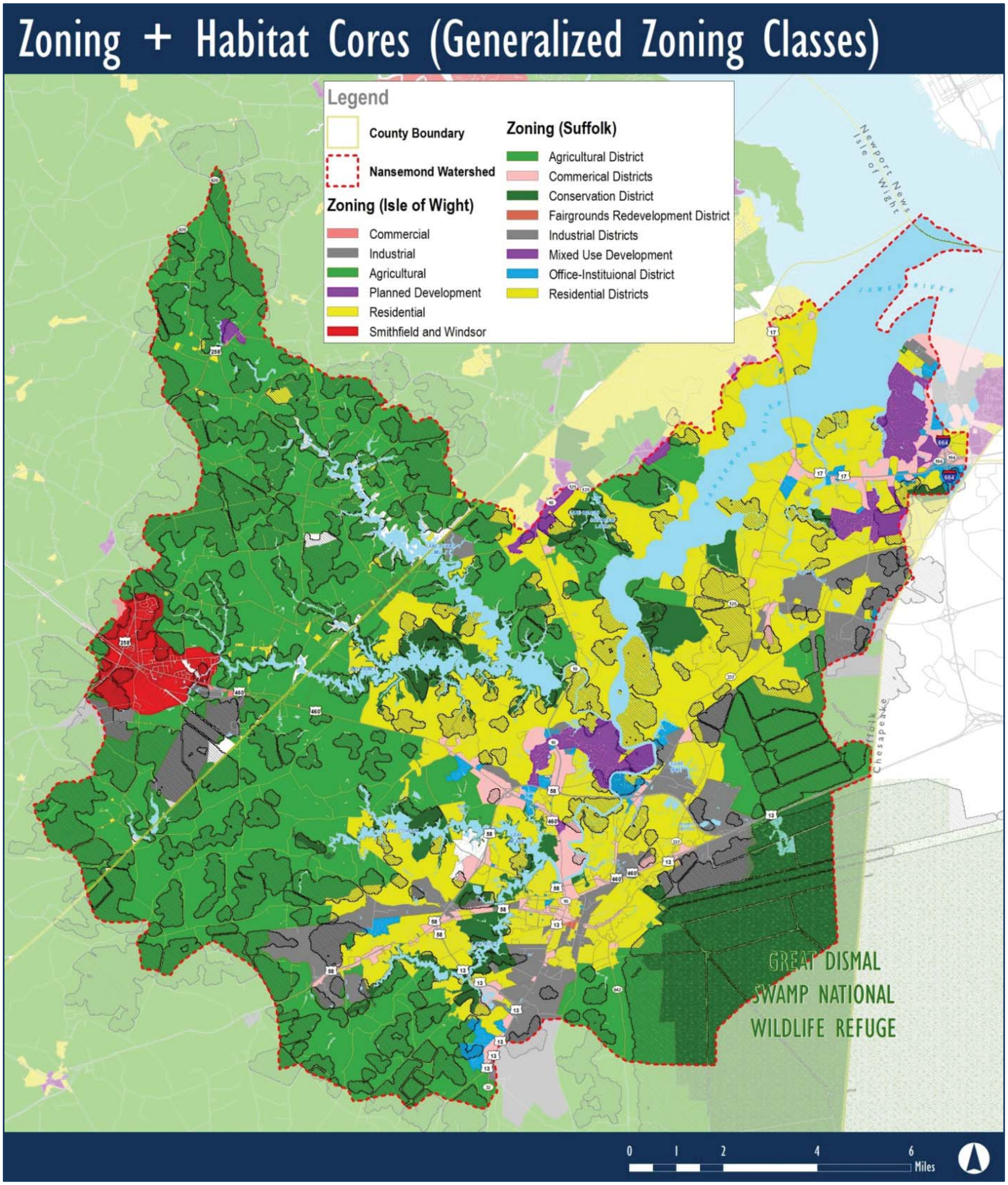
Growth management is also not a new idea for Isle of Wight County. The County first designated "Growth Areas" in its 1977 Comprehensive Plan. The 1991 Comprehensive Plan reinforced the notion of designated areas for growth in the County and established three "Development Service Districts" (DSDs) which in recent years have served and are expected to continue to serve as the principal locations for residential, commercial and employment growth in the County. Isle of Wight County only has one (1) DSD, the Windsor District, located within the Nansemond River watershed.



The estimated development pressure for each habitat core in the Nansemond River watershed is shown below. The factors used to determine high development pressure include: proximity to major roads, proximity to cities and towns, proximity to existing development, designated Growth Areas, zoning, and parcels that have been subdivided but where no construction has taken place. The factors used to determine a low development pressure include: conserved areas, wetlands, and areas within the 100 year floodplain.



A variety of additional factors may also be useful for an analysis of development pressure; such as, proximity to city water and sewer, schools, job hubs, land values, and tax rates. This data can be used to help prioritize the conservation of high risk habitat cores before they are lost.



As previously mentioned, the present and future zoning regulations in both localities will have a large impact on development patterns. Overlaying habitat core data with current zoning helps to identify habitat cores that may be at greater risk for development. This information can help inform future planning decisions, such as whether to expand or retain the current size of the Growth Areas.

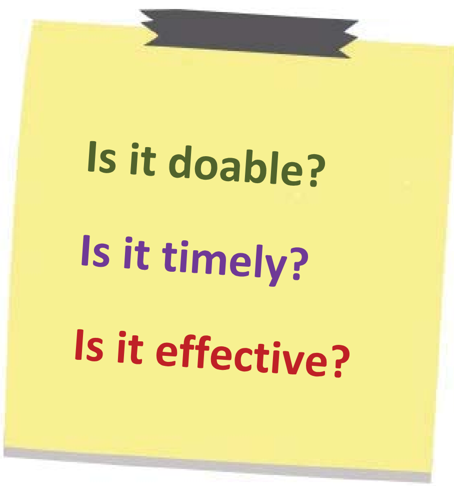
GOALS & OBJECTIVES

The final phase of this study consists of goals, objectives, and example tasks that were developed as a result of public engagement, committee meetings, and assistance from the Green Infrastructure Center. The following goals, objectives, and example tasks reinforce the project team's overall vision statement which is restated below:

Suffolk will support a culture that is equally concerned with the natural and the built environment. Suffolk will become a destination for outdoor recreation, with access to the Nansemond River and support and protection for its diverse culture.

Some of the objectives and example tasks require funding to carry out, while others require a change in practice, policy, or cross agency coordination. Over time, these goals, objectives and tasks may be further refined, expanded, or altered as the needs of the community change. This list serves as a starting point and should be revisited, analyzed, and updated as needed.

The green infrastructure committee utilized the following parameters to help evaluate the public comments from the second community forum.

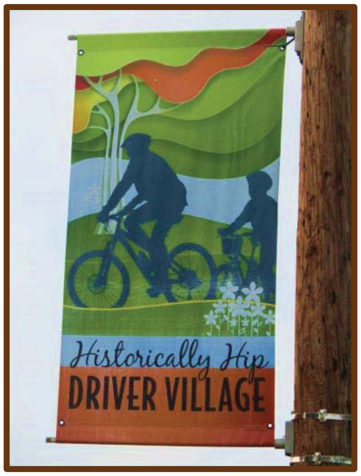


- ✓ **Doable?** If yes, how can it be achieved, how much might it cost and can funds be raised, provided or leveraged?
- ✓ **Timely?** Is it needed urgently or can it tag onto existing or upcoming processes or programs, such as Suffolk's bike and pedestrian planning efforts?
- ✓ **Effective?** Does it meet a key, identified need? Is it the best solution for the problem at hand?

Should the green infrastructure study be expanded or conducted again in the future, goals and objectives could also be assessed in terms of estimated funding costs and timeframes for completion; these parameters were too specific for the purpose of this initial study.

Goal #1: Protect and Connect Habitats to Support Biodiversity and Healthy Landscapes	
Objective 1A:	**Improve connectivity between natural habitats and environmentally critical areas; discourage fragmentation and isolation of natural habitats.**
Example tasks:	• Encourage new developments to accommodate natural features/green infrastructure first and plan for grey infrastructure second. • Promote collaboration among landowners and across parcels to connect habitat areas and create wildlife corridors in order to allow for the movement of animal and seed species. • Assess open space requirements and increase requirements where appropriate, especially to improve connectivity. • Explore opportunities for public and private land conservation in environmentally sensitive areas (conservation easements, transfer of development rights, transfer of density, land acquisition, overlay districts).
Objective 1B:	**Support and expand tree canopy cover within the watershed.**
Example tasks:	• Develop a budget for tree planting and maintenance. • Establish realistic tree planting goals for the Growth Areas. (Currently the Central Growth Area tree canopy is 27% and the Northern Growth Area tree canopy is 20 %.) • Use the green infrastructure maps to guide the selection of planting locations. Place a special focus on Main Street and Washington Street, as well as playgrounds. • Explore the possibility of becoming a 'Tree City USA' through the National Arbor Day Foundation in order to allow the city to qualify for tree planting grants or educational grants. • Consider holding tree planting events and campaigns (such as memorial trees to commemorate the passing of loved ones). • Encourage new developments to minimize the clearing of trees, vegetation and top soil, which is especially important within the Resource Protection Area.
Objective 1C:	**Preserve the existing plant species native to southeast Virginia.**
Example tasks:	• Revise the replacement planting tree lists in Isle of Wight and Suffolk to feature more native species. • Explore incentives for preserving existing native species rather than planting new non-native species.

Goal #2: Improve and Protect Water Quality for Wildlife, Fish, and People	
Objective 2A:	**Reduce urban stormwater runoff by increasing tree canopy within the watershed.**
Example tasks:	• Consider increases in tree canopy requirements for new development, especially parking lots. • Explore incentives for developers to provide additional tree canopy above and beyond the city's minimum requirements. • Explore trade-off opportunities to provide more landscaping in place of traditional BMPs.
Objective 2B:	**Reduce stormwater runoff by decreasing the amount of impervious surfaces within the watershed.**
Example tasks:	• Consider policy changes to relieve small parking lots or lots that are seldom used from providing paved parking and other associated improvements (curb and gutter). • Explore incentives for the use of pervious pavement in place of impervious pavement.
Objective 2C:	**Promote alternative stormwater management techniques.**
Example tasks:	• Establish design guidelines or best practices for alternative stormwater management techniques. • Explore the potential for regional stormwater treatment and co-location of stormwater infrastructure.
Objective 2D:	**Protect riparian habitat (marsh, grasses, etc.).**
Example tasks:	• Consider opportunities to educate the community about river stewardship; for example: develop a Nansemond River Docent Program. • Support volunteer organizations that clean-up the watershed and host educational events (such as oyster seeding). • Continue to mitigate impacts to the riparian habitat by maintaining the City of Suffolk Wetlands Board.
Objective 2E:	**Discourage development and removal of vegetation within the Resource Protection Area (RPA).**
Example tasks:	• Maintain the Chesapeake Bay Preservation Area Overlay District which establishes requirements for new development and modifications made within the Resource Protection Area. • Provide examples of good low-impact development in the RPA.
Objective 2F:	**Protect properties within or adjacent to the flood zone in order to minimize property damage and negative environmental impacts.**
Example tasks:	• Explore opportunities for the City to rezone flood prone areas. • Consider opportunities for the City to acquire properties within or adjacent to the flood zone that could be utilized as open space.

Goal #3: Expand Parks and Trails Throughout the Nansemond River Watershed to Improve Community Health and Access to Nature.	
Objective 3A:	**Ensure equitable distribution and connectivity of parks and trails.**
Example tasks:	• Incorporate green infrastructure study comments in the Bike and Pedestrian Master Plan. • Encourage new developments and redevelopments to tie into existing local and regional trail networks. • Encourage new developments and redevelopments to include bike facilities such as racks, lockers and repair stations.  • Create complete 'green' streets that combine bike and pedestrian facilities with stormwater treatment. • Investigate the co-location of trails along right-of-way easements such as along the Shingle Creek sanitary easement. • Add more bike and pedestrian connections to the Great Dismal Swamp, especially from downtown Suffolk. • Connect city parks to adjacent communities.  • Create a walking trail from the Kimberly Bridge along the Nansemond River, behind big box stores, Obici Place, and businesses along Lake Meade/Nansemond River. • Overall, provide more recreational opportunities in the south and western portions of the City which currently lack parks and trails.
Objective 3B:	**Promote river stewardship by expanding recreational opportunities in the Nansemond River watershed and its tributaries.**
Example tasks:	• Investigate potential sites for creating motorized boat access in close proximity to downtown. • Evaluate potential sites for canoe/kayak launches, ideally 3-5 miles apart from one another. • Evaluate potential sites for fishing that do not conflict with other recreational activities. 

Goal #4: Promote and Protect the City’s Rich Heritage and Culture	
Objective 4A:	**Re-implement and enhance the existing historic walking tour to promote education, enjoyment and walking in the downtown area.**
Example tasks:	• Identify volunteer organizations to conduct walking tours. • Consider developing a walking tour map and script. 
Objective 4B:	**Develop wayfinding signs and themed tourist routes to increase tourism and support local businesses.**
Example tasks:	• Create themed tourist routes (e.g. the tea tour, the peanut path). • Consider partnerships with various organizations such as the Suffolk Nansemond Historic Society and the Tourism Division to develop themes and locations. • Explore the use of interactive kiosks in public buildings to provide information on local history and current events. 

CONCLUSION

The completion of this green infrastructure study represents a significant milestone on the road to making the communities of the Nansemond River watershed more conscientious about the health and benefits of natural landscapes. The City of Suffolk and the Green Infrastructure Center, along with Isle of Wight County and our community partners, have developed tools to help value green infrastructure and the services it provides to wildlife, the economy, and residents and visitors alike. By investing in the protection, conservation, and expansion of green infrastructure, the Nansemond River watershed will become an even more desirable place to live, work, and play. In addition, by strengthening water quality protection and habitats in the watershed, the entire region's ecosystem will benefit.

This study and the data it produced identify and quantify various types of green infrastructure resources present in the Nansemond River watershed. This information will help inform better decision making as the communities around the Nansemond continue to grow. The ultimate goals for conducting this study are to use this data and public input to help inform future planning initiatives, guide responsible resource management within the Nansemond River watershed, and guide smart integration of green infrastructure considerations into a variety of other plans and practices.

As the objectives and tasks of this plan are carried out over many years, habitats will grow stronger and more connected, water quality will improve, more recreational access will be provided on the Nansemond River, parks and trails will be better linked, and historically significant sites will be preserved for future generations.

APPENDIX A: COMMITTEE ANNOTATED PUBLIC COMMENTS

The following comments were recorded from the December 1, 2016, public forum held at Suffolk City Hall. These comments were annotated by the committee, shown in italics below, at their January, 19th 2017 meeting. [#] indicates the comment frequency.

Goal 1: Protect and Connect Habitat to Support Biodiversity and Healthy Landscapes

- Convert vacant land next to Farmer's Bank on Godwin Boulevard to a park [*consider a public private partnership*.]
- Make the city area north of the Kimberly Bridge walkable and connected to the Hilton Hotel area. *This is happening. Meets objective 2.*
- Revise replacement planting tree list in Isle of Wight and Suffolk to feature more native species. *(added as task)Meets objective 3.*
- Make pervious parking lots at Obici Hospital and plant trees along Route 10 north of the hospital.
- Plant more trees along Main Street [2] and Washington Street *and playground perimeter areas. Added detail to objective 1.*
- Plant fruit trees especially downtown, but throughout the entire city.
- Re-zone some of the land to the East of Wawa on Godwin Boulevard to accommodate green space *before* the land is developed.
- Provide access to the Blackwater River/South Quay (*outside of Nansemond River Watershed*).
- *Plant school gardens.*

Improve and Protect Water Quality for Wildlife, Fish and People

- Encourage permeable parking technology and require new developments to have permeable parking spaces.
- Build rain gardens to capture stormwater run-off.
- Require bicycle parking as a standard in new developments.
- Develop minimum requirements for tree canopy cover of new developments.
- Minimize impervious pavement by reducing requirements for seldom used parking lots.
- Require city staff reports and plans for development to consider and discuss green infrastructure.
- Conduct research along the Nansemond River and determine ways to improve water quality and reduce bacteria (WQ1).
- There are several hundred new apartments that should be represented on the maps (WQ2).
- Efforts should be taken to reduce alligator grass in streams and ponds. (WQ3).
- Identify parcels (or portions of parcels) that may be retrofitted for stormwater retention/management.
- Consider allowing off-site or consolidated stormwater/BMP facilities in "odd corner" parcels, preserving values of better-located parcels.
- If the proposed 460 bypass through wetlands is adopted, require specific amounts of tree replacements as part of the project.
- Increase oyster growth.
- Preserve natural areas throughout the city as they attract visitors to Suffolk.

Provide and Expand Parks and Trails Throughout the Nansemond River Watershed to Improve Community Health and Access to Nature.

- Consider this site for a future park; it has the potential for water access (T1).
- Consider creating a new access point for The Great Dismal Swamp (T2).
- Consider installing a bike trail along Route 58 (T3).
- Consider an HRSD trail potential (T5).
- Add more bike trails.
- Widen Route 10 and create a green connection to Chuckatuck (T7).
- Lake Prince Woods has new local trails (T8).
- Create trails that are separate from roadways.
- Create a walking trail from the Kimberly Bridge along the Nansemond River, behind big box stores (Suffolk Plaza, Walmart, Lowes and VDOT) to behind Obici Place and behind businesses along Lake Meade/Nansemond (T9).
- Incorporate Complete Green Streets. Be sure they prominently feature vegetation.
- Construct a boat ramp downtown across from the Hilton. Purchase the land and place it in a conservation easement. Crittenden, Eclipse and Hobson should not be excluded.
- Add habitat and beauty to the new stormwater pond to be build off of Bethlehem Court (T11).
- Lone Star Lakes Park has some trails. Connect the city to them!
- Add the Nansemond Indian Tribe Maitonock Town to the map (T14).
- Make a sidewalk to connect Hillpoint to Downtown (including an overpass over Route 58) (T16).
- Create trails for horses, walkers and bicyclists.
- Define clear standards for trail design.
- Construct a footbridge over the river allowing residents to access box stores (T21).
- Add many more canoe launch spots on the Nansemond East of the city.
- Co-locate trail on Hampton Roads Sanitary District right of way.
- TCC Site (ULI Study)
- Acquire open space parcels from a willing seller in the vicinity of Jericho Lane to preserve access to The Great Dismal Swamp. Build a visitor's center to increase environmental and historical knowledge.

Promote and Protect the Rich Culture and Heritage in the Watershed

- Add St. John's Episcopal Church to the map of historic places. It is on the National Register of Historic Places (H1).
- Introduce GeoCaching to the area!
- Develop a historic museum to include the development history of Suffolk, the peanut industry, the Great Dismal Swamp, Native Americans, African American history, Civil and Revolutionary War history and John Smith. Make a short movie to play at the entrance of the museum!
- Add Century Farm Indika Farm to the map (H2).
- Preserve the historical sites that exist now. Don't tear them down.
- Develop a walking or biking trail complete with markers of Lord Cornwall's march.
- Mark and commemorate the Lafayette Trail and the Civil and Revolutionary Wars in South Quay.
- Create a trail analogous to the Luray Walking Trail.
- Convert the old Tidewater Community College to a riverfront park (H3).
- Place Mr. Peanut statues around town to highlight the city's agricultural history. Encourage local artists to create the statues and allow the city to buy the final products. *Mr. Peanut is trademarked, but the peanut trail symbol could be substituted.*
- Develop a meditative maze for the core downtown area.
- When redeveloping ensure that cultural context is retained. Decrease massiveness of buildings and increase green space.

- 1400 Sleepy Hole Road – Bay Point Farm
- Nansemond County Training School (H4).
- Mount Sinai Baptist Church (H5).

The following sites were identified as potential walking tour sites:

- Suffolk Female Institute/Suffolk College
- Suffolk Center
- Old National Bank Building
- Old Train Station
- First Episcopal Church
- Baker Funeral Home
- Constanzia Home
- Tiffany House
- Penner Houses
- 204 Bank Street – Bed and Breakfast
- Allan House
- R.W. Baker – Sequoia Tree

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